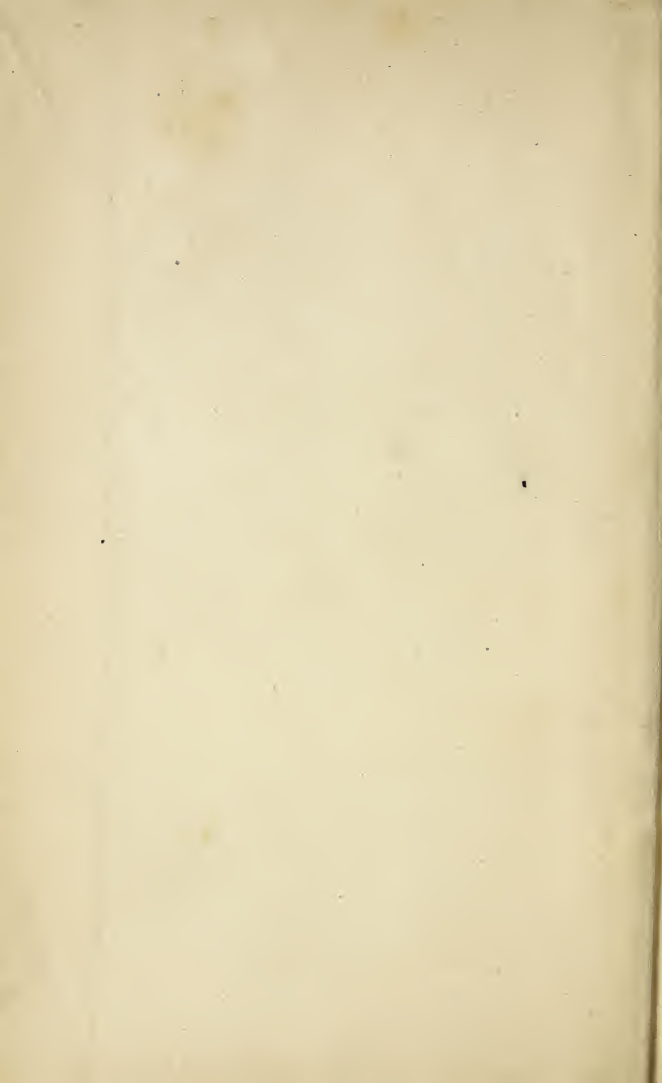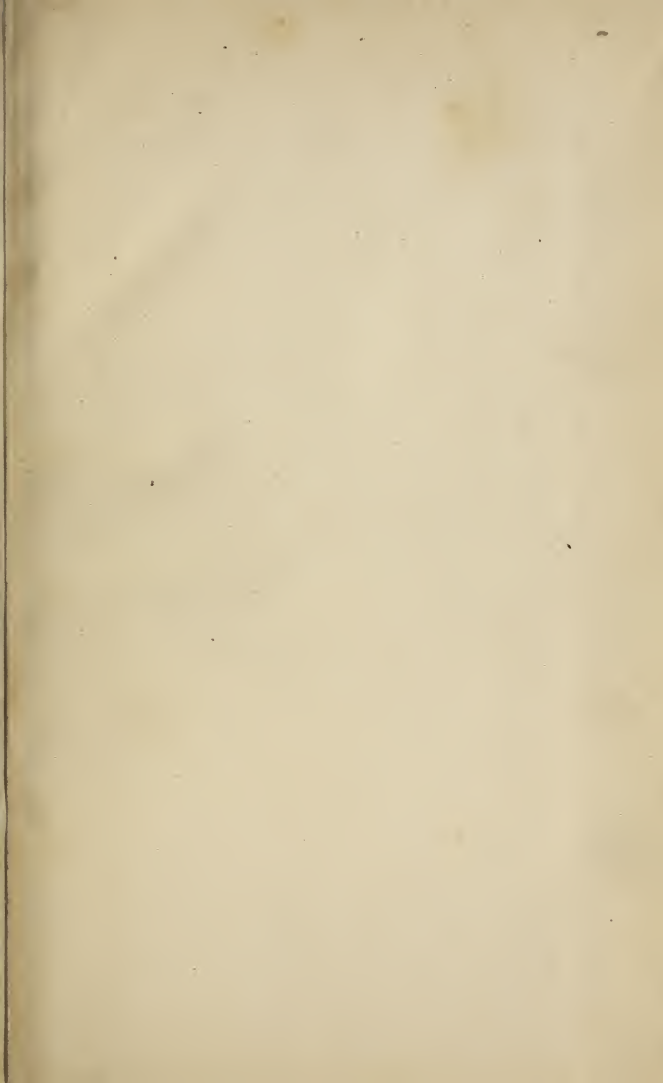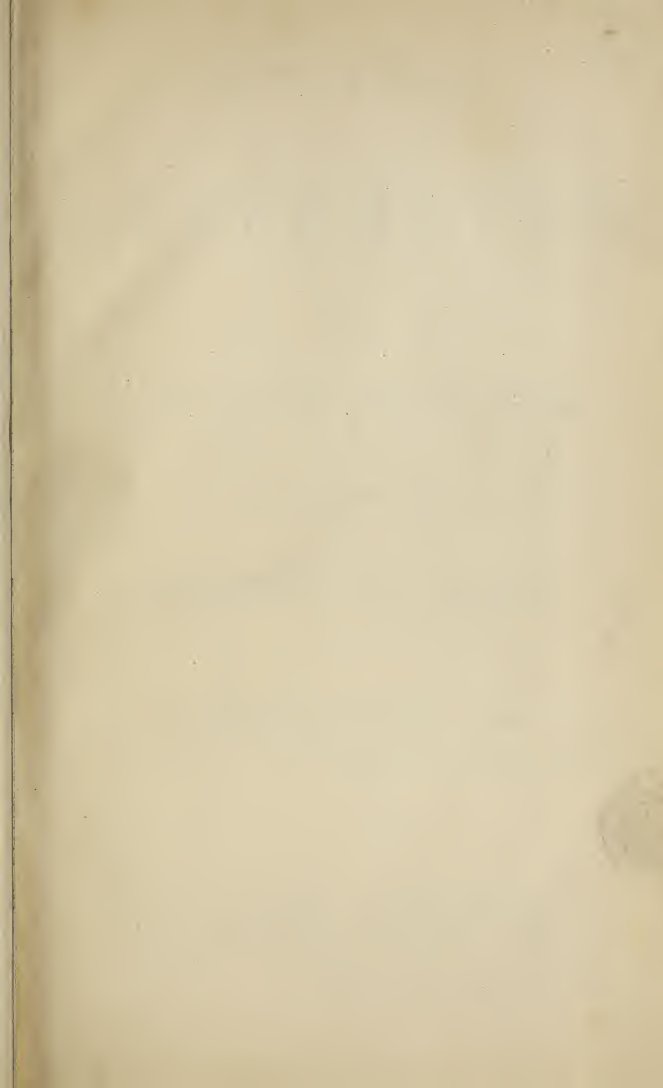# DAVIES'

INTELLECTUAL

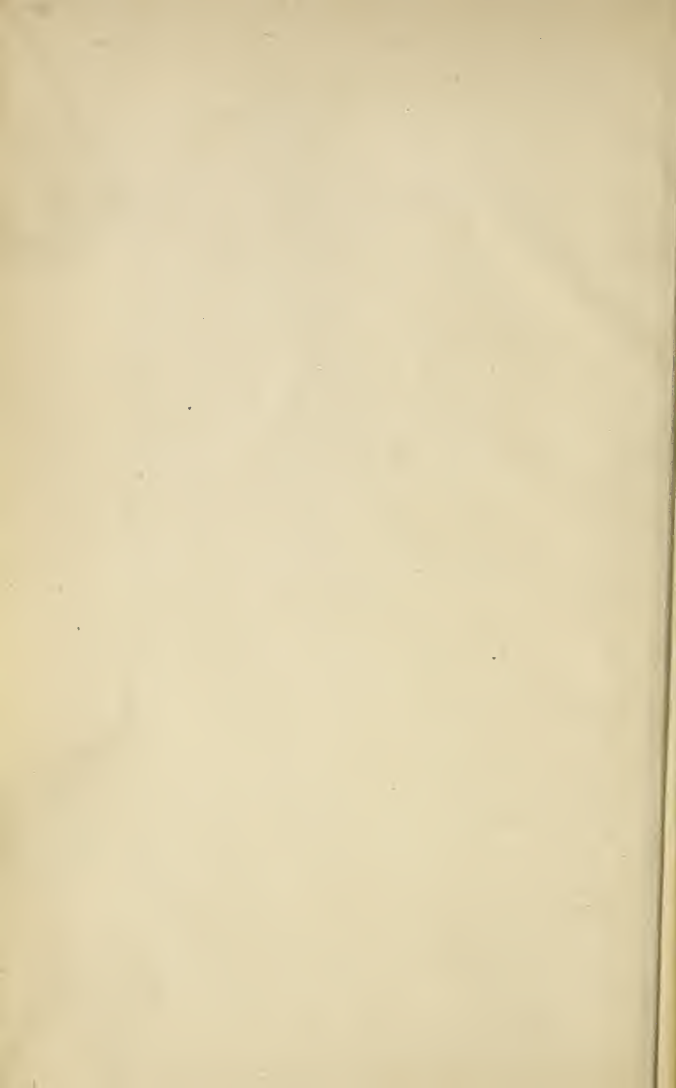## ARITHMETIC.

N. ORR - CO.

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INTELLECTUAL

ARITHMETIC:

BEING

AN ANALYSIS OF THE SCIENCE OF NUMBERS,

WITH SPECIAL REFERENCE TO

MENTAL TRAINING AND DEVELOPMENT.

By CHARLES DAVIES, LL.D.,

AUTHOR OF A FULL COURSE OF MATHEMATICS.

SUGGESTIONS.

1. Sensible objects should be used in all the elementary operations of numbers.

2. The *unit* of a number, and the number of units taken, should be dwelt upon in every example.

3. The idea of number is purely abstract, and can only be apprehended by the contemplation of sensible objects—individually, and collectively.

4. The eight units of science, arranged into classes in the Tables, should be carefully distinguished from each other.

5. The idea of the abstract unit, 1, comes from contemplating the denominate unit, 1 apple. The unit of currency, 1 dollar, is easily apprehended; and the foot-rule, or the yard-stick, will fix permanently in the mind the unit of length.

6. The unit of surface, is the square constructed on the unit of length; and a paper cube, constructed on this square, as a base, exhibits to the mind one of the units of volume. The gallon measure, and the half-bushel, are two other units of volume in common use.

7. The pound, is the most familiar unit of weight, and should be exhibited to every class of beginners. The day, is the familiar unit of time, and the degree, of angular measure.

DAVIES' NEW SERIES.

I. PRIMARY ARITHMETIC.

The elementary combinations, by object lessons.

II. ELEMENTS OF WRITTEN ARITHMETIC.

Intermediate. Prominently practical. Rules secondary.

III. PRACTICAL ARITHMETIC.

The whole subject, practical and theoretical.

I. A.

INTRODUCTION.

Every book of instruction should have a specific object, to which the entire work, both in matter and method, should strictly conform.

It is the object of this book to train and develop the mind by means of the science of numbers. Numbers are the instruments here employed to strengthen the memory, to cultivate the faculty of abstraction, and to sharpen and develop the reasoning powers.

Numbers are all derived from the unit 1, either by addition or division. Hence, every idea connected with number, must, in a final analysis, be referred to the idea of 1.

The elementary principle, in any branch of knowledge, is the thing first to be learned, and then the law connecting this principle with those which follow it. It is not till we have reached the final principle, and discovered the law which unites all the principles in one harmonious whole, that we acquire any thing deserving the name of science.

To learn one thing at a time—to learn that thing thoroughly—and to learn its connections with all other things, are the golden steps that lead to the temple of truth.

The syllogism of Aristotle,

> All men are mortal :
> Mr. Jones is a man :
> *Therefore*, Mr. Jones is mortal,—

is the form, in substance, by which we pass from what is known to what is unknown, in all the processes of mathematical reasoning.

This formula of reasoning, called, in general logic, a *Syllogism*, and in the reasoning on numbers, an *Analysis*, has three parts:

1. The first proposition, (All men are mortal), is called, the *major premise ;*

2. The second proposition, (Mr. Jones is a man), is called, the *minor premise ;* and,

3. The third proposition, (*Therefore*, Mr. Jones is mortal), is called, the *conclusion.*

The major and minor premises are always known, and the conclusion follows from them.

The parts of the analysis have not, *technically*, the same relation to each other as the parts of the syllogism, though in substance they are the same; for, if the first two propositions are admitted, the third must be true. Every true analysis may, however, be reduced to the exact form of the syllogism by very simple transformations, and

thus the syllogism becomes the final test of every mathematical truth.

What is the sum of 3 and 5?

ANALYSIS.—A number which contains as many units as the numbers added, is their *sum :*

8 contains as many units as 3 and 5 :

Therefore, 8 is the sum of 3 and 5.

What is the difference between 5 and 3?

ANALYSIS.—A number which added to the less of two numbers gives the greater, is their *difference :*

2 added to 3, gives 5 :

Therefore, 2 is the difference between 5 and 3.

Again : If 1 barrel of flour costs 6 dollars, what will 5 barrels cost?

ANALYSIS.—Five barrels will cost 5 times as much as 1 barrel :

1 barrel costs 6 dollars :

Therefore, 5 barrels will cost 5 times 6 dollars, which is 30 dollars.

What is assumed, or taken for granted, in the analysis of numbers, is,—

1st. That the definitions are true ;

2d. That the value, or measure of numbers is proportional to the number of units which they contain ; and,

3d. That quantity is proportional to cost, or cause to effect.

These principles, and the formula of the syllogism, will indicate the form of every analysis.

The diagram, page 64, will, I think, be found useful, in illustrating the principles of Fractions. Indeed, I think it divests that subject of all its difficulties. The principle is very simple, and therefore valuable. It consists in dividing the unit 1 into equal parts, corresponding to the numbers of a class, so that each boy shall have a fractional unit denoted by his class number. This is the gist of the whole matter. The diagram applies this principle to object-teaching, and presents the whole subject of Fractions under a new form.

Another important change has been made in treating the subject of Ratio, in connection with Denominate Numbers, which brings to the aid of this abstract and difficult part of Arithmetic, the principles of object-teaching. The adoption of a tangible unit, as a standard, and the illustration of all the principles, by the relations of denominate instead of abstract units, will, it is hoped, have freed the subject of all its difficulties.

COLUMBIA COLLEGE,
New York, July, 1862.

INTELLECTUAL ARITHMETIC.

SECTION FIRST.

LESSON I.

1. How many fingers have you on each hand, not counting the thumb? How many on both hands?

2. Counting the thumb, how many have you on each hand? How many on both?

3. John has 3 cents in his purse, and his father gives him 1: how many has he then?

4. If James has one apple, and buys 5 others, how many will he then have?

5. If Charles has six pears, and William gives him three others, how many will he then have?

6. If Isaac has nine marbles, and wins one from James, how many will he then have?

7. Levi killed 5 squirrels in the forenoon, and 3 in the afternoon: how many did he kill in all?

8. Nathan buys a top for 8 cents, and a pencil for 2 cents: how many cents does he pay for both?

9. A farmer buys a sheep for 3 dollars, and a calf for 5 dollars: how much does he pay for both?

10. John had three apples, and William gave him 6: how many did he then have?

11. Mary has 2 roses, and Jane 5: how many roses have both?

12. If you buy a pint of nuts for 6 cents, and an orange for 3 cents, how many cents do you pay for both?

13. James bought 3 pencils, and John 5: how many pencils did both buy?

14. Lucy has 9 needles, and Jane 3: how many needles have both?

15 John has 7 peaches in a basket, and two in his hand: how many has he in all.

---

16. One and one, are how many?   1 and 1?
17. One and two, are how many?   2 and 1?
18. One and three, are how many?   3 and 1?
19. One and four, are how many?   4 and 1?
20. One and five, are how many?   5 and 1?
21. One and six, are how many?   6 and 1?
22. One and seven, are how many?   7 and 1?
23. One and eight, are how many?   8 and 1?
24. One and nine, are how many?   9 and 1?
25. One and ten, are how many?   10 and 1?
26. Two and one, are how many?   1 and 2?
27. Two and two, are how many?   2 and 2?
28. Two and three, are how many?   3 and 2?
29. Two and four, are how many?   4 and 2?
30. Two and five, are how many?   5 and 2?
31. Two and six, are how many?   6 and 2?
32. Two and seven, are how many?   7 and 2?
33. Two and eight, are how many?   8 and 2?
34. Two and nine, are how many?   9 and 2?
35. Two and ten, are how many?   10 and 2?
36. Three and one, are how many?   1 and 3?
37. Three and two, are how many?   2 and 3?
38. Three and three, are how many?   3 and 3?
39. Three and four, are how many?   4 and 3?

40. Three and five, are how many?   5 and 3 ?
41. Three and six, are how many?   6 and 3 ?
42. Three and seven, are how many?   7 and 3 ?
43. Three and eight, are how many?   8 and 3 ?
44 Three and nine, are how many?   9 and 3 ?
45. Three and ten, are how many?   10 and 3 ?

LESSON II.

1. John has four tops, and Charles one : how many tops have both ?

2. William has four apples, and James three : how many apples have both ?

3. John has four chestnuts in one hand, and three chestnuts in the other : how many chestnuts has he in both hands ?

4. Charles has four quills, and John seven : how many quills have both ?

5. John and James have each four tops : how many tops have both ?

6. William has four birds in one cage, and seven in another : how many birds in both cages ?

7. If Jane has four pins in her cushion, and puts in six more, how many pins will she then have in it ?

8. If Mary has four needles, and buys eight, how many needles will she then have ?

9. John buys pears for four cents, and apples for eight cents : how many cents does he pay for all ?

10. John has five marbles in one hand, and eight in the other : how many marbles has he in both hands ?

11. If Charles has five cents, and his father gives him seven, how many cents will he then have ?

2*

12. John has five apples, and Reuben gives him nine : how many has he then ?

13. Isaac buys paper for five cents, and pencils for ten cents : how many cents does he pay for all ?

14 If I buy five oranges for five cents, and six oranges for six cents, how many do I buy ?

15. William carries six apples to school in his basket, and Henry four : how many apples in both baskets ?

16. John has six apples, and his sister Jane gives him five : how many has he then ?

17. Charles has six apples, and buys eight from John : how many has he then ?

18. William buys three tops for six cents, and eight tops for ten cents : how many tops does he buy ?

19. James buys six eggs for six cents, and eight eggs for nine cents : how many eggs does he buy ?

————

20. Four and one, are how many ?	1 and 4 ?
21. Four and two, are how many ?	2 and 4 ?
22. Four and three, are how many ?	3 and 4 ?
23. Four and four, are how many ?	4 and 4 ?
24. Four and five, are how many ?	5 and 4 ?
25. Four and six, are how many ?	6 and 4 ?
26. Four and seven, are how many ?	7 and 4 ?
27 Four and eight, are how many ?	8 and 4 ?
28. Four and nine, are how many ?	9 and 4 ?
29. Four and ten, are how many ?	10 and 4 ?
30. Five and one, are how many ?	1 and 5 ?
31 Five and two, are how many ?	2 and 5 ?
32 Five and three, are how many ?	3 and 5 ?
33. Five and four, are how many ?	4 and 5 ?
34. Five and five, are how many ?	5 and 5 ?
35. Five and six, are how many ?	6 and 5 ?

36. Five and seven, are how many?   7 and 5 ?
37. Five and eight, are how many?   8 and 5 ?
38. Five and nine, are how many?   9 and 5 ?
39. Five and ten, are how many?   10 and 5 ?
40 Six and one, are how many?   1 and 6 ?
41. Six and two, are how many?   2 and 6 ?
42. Six and three, are how many?   3 and 6 ?
43. Six and four, are how many?   4 and 6 ?
44. Six and five, are how many?   5 and 6 ?
45 Six and six, are how many?   6 and 6 ?
46. Six and seven, are how many?   7 and 6 ?
47. Six and eight, are how many?   8 and 6 ?
48. Six and nine, are how many?   9 and 6 ?
49. Six and ten, are how many?   10 and 6 ?

LESSON III.

1. James has seven oranges in one basket, and six in another: how many oranges in both?

2. William has seven apples, and John gives him nine: how many apples has he then?

3. A father has two sons, and gives seven cents to each: how many cents does he give to both?

4. If Henry buys seven apples, and Mary gives him nine, how many will he then have?

5. If George buys, at the store, seven quills at one time, and 8 quills at another time, how many will he buy in all?

6. If William has 5 marbles, and Henry gives him 8, how many will he then have?

7. A boy has eight marbles, and gains five: how many marbles has he then?

8. If John has eight marbles, and gains nine, how many will he have?

9. If George buys eight marbles for three cents, and eight more for four cents, how many will he buy in all?

10 John has eight marbles, and Charles gives him nine: how many has he then?

11. Charles has nine apples, and buys five more: how many apples has he then?

12. If James has nine pears, and buys eight more, how many will he then have?

13. If James buys nine oranges for nine cents, and eight more for 9 cents, how many will he buy in all?

14. If six sheets of paper cost nine cents, and 2 pencils one cent, what do the paper and pencils cost?

15. James has ten pencils, and then buys eight: how many has he then?

16. John gives ten chestnuts to Henry, and nine to William: how many does he give to both?

17. James spends six cents for candy, and eight cents for nuts: how much does he spend in all?

18. Nancy has ten pins in her cushion, and sticks in nine more there: how many pins are there then in it?

19. Jane has ten needles, and Lucy gives her seven: how many does she then have?

20. Oliver buys ten oranges for twelve cents, and ten more for eight cents: how many does he buy?

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21. Seven and one, are how many?	1 and 7 ?
22. Seven and two, are how many?	2 and 7 ?
23. Seven and three, are how many?	3 and 7 ?
24. Seven and four, are how many?	4 and 7 ?
25. Seven and five, are how many?	5 and 7 ?
26. Seven and six, are how many?	6 and 7 ?

27. Seven and seven, are how many?   7 and 7?
28 Seven and eight, are how many?   8 and 7?
29 Seven and nine, are how many?   9 and 7?
30. Seven and ten, are how many?   10 and 7?
31 Eight and one, are how many?   1 and 8?
82 Eight and two, are how many?   2 and 8?
33 Eight and three, are how many?   3 and 8?
34. Eight and four, are how many?   4 and 8?
35. Eight and five, are how many?   5 and 8?
36. Eight and six, are how many?   6 and 8?
37. Eight and seven, are how many?   7 and 8?
38. Eight and eight, are how many?   8 and 8?
39. Eight and nine, are how many?   9 and 8?
40. Eight and ten, are how many?   10 and 8?
41. Nine and one, are how many?   1 and 9?
42. Nine and two, are how many?   2 and 9?
43. Nine and three, are how many?   3 and 9?
44 Nine and four, are how many?   4 and 9?
45 Nine and five, are how many?   5 and 9?
46 Nine and six, are how many?   6 and 9?
47. Nine and seven, are how many?   7 and 9?
48. Nine and eight, are how many?   8 and 9?
49 Nine and nine, are how many?   9 and 9?
50. Nine and ten, are how many?   10 and 9?

LESSON IV.

1 Ten and ten, are how many?   10 and 10?
2 Ten and twenty, are how many?   20 and 10?
3. Ten and thirty, are how many?   30 and 10?
4. Ten and forty, are how many?   40 and 10?
5. Ten and fifty, are how many?   50 and 10?

6. Ten and sixty, are how many?   60 and 10?

7. Ten and seventy, are how many?   70 and 10?

8 Ten and eighty, are how many?   80 and 10?

9. Ten and ninety, are how many?   90 and 10?

10. Two and two, are how many?   12 and 2?   22 and 2?   32 and 2?   42 and 2?   52 and 2?   62 and 2?   72 and 2?   82 and 2?   92 and 2?   94 and 2?   96 and 2?   98 and 2?

11. Three and 3, are how many?   13 and 3?   23 and 3?   33 and 3?   43 and 3?   53 and 3?   63 and 3?   73 and 3?   83 and 3?   93 and 3?   96 and 4?

12. Four and 4, are how many?   14 and 4?   24 and 4?   34 and 4?   44 and 4?   54 and 4?   64 and 4?   74 and 4?   84 and 4?   94 and 4?   98 and 2?

13. Five and 5, are how many?   15 and 5?   25 and 5?   35 and 5?   45 and 5?   55 and 5?   65 and 5?   75 and 5?   85 and 5?   95 and 5?

14. Six and 6, are how many?   16 and 6?   26 and 6?   36 and 6?   46 and 6?   56 and 6?   66 and 6?   76 and 6?   86 and 6?   96 and 6?

15. Seven and 7, are how many?   17 and 7?   27 and 7?   37 and 7?   47 and 7?   57 and 7?   67 and 7?   77 and 7?   87 and 7?   97 and 7?

16. Eight and 8, are how many?   18 and 8?   28 and 8?   38 and 8?   48 and 8?   58 and 8?   68 and 8?   78 and 8?   88 and 8?   98 and 8?

17. Nine and 9, are how many?   19 and 9?   29 and 9?   39 and 9?   49 and 9?   59 and 9?   69 and 9?   79 and 9?   89 and 9?   99 and 9?

18. The sign, +, is called *plus*. When placed between two numbers, it denotes that they are to be added together.

The result obtained by adding two or more numbers, is called their *sum*. The *sum* contains as many units as there are in the numbers added.

The sign, $=$, is called the sign of *equality*. When placed between numbers, it denotes that the number of units on the left is equal to the number on the right; thus,

$$1 + 2 + 3 + 4 = 10.$$

19. $1 + 5 + 6$, are how many? $2 + 5 + 3 + 1$?
20. $3 + 7 + 1$, are how many? $0 + 2 + 9 + 3$?
21. $7 + 3 + 7$, are how many? $2 + 5 + 0 + 6$?
22. $8 + 7 + 6 + 0$, are how many? $9 + 8 + 7$?

LESSON V.

1. What is the sum of 26 and 37?

ANALYSIS.—*26 is equal to 2 tens and 6 units; 37 is equal to 3 tens and 7 units; 2 tens and 3 tens are 5 tens, or 50; and 6 units and 7 units are 13 units, which added to 50 make 63: Therefore, the sum of 26 and 37 is 63.*

2. $10 + 20 + 4$, are how many? $25 + 26$?
3. $10 + 30 + 8$, are how many? $29 + 30$?
4. $20 + 20 + 9$, are how many? $40 + 10$?
5. $15 + 20 + 6$, are how many? $41 + 50$?
6. $25 + 30 + 9$, are how many? $50 + 40$?
7. $16 + 25 + 12$, are how many? $47 + 30$?
8. $17 + 30 + 9$, are how many? $56 + 21$?
9. $30 + 60 + 9$, are how many? $57 + 18$?
10. $15 + 39 + 10$, are how many? $60 + 27$?
11. $10 + 15 + 47$, are how many? $70 + 15$?
12. $14 + 16 + 50$, are how many? $85 + 15$?

13. James paid 5 cents for an orange, and 9 cents for a pencil : how many cents did he pay for both ?

ANALYSIS.—*He paid as many cents for both, as there are cents in the sum of 5 cents and 9 cents : 5 and 9 are 14 : Therefore, he paid 14 cents.*

14. Jane has 13 pins in her cushion, and Mary has 27 in hers : how many pins in both cushions ?

15. John, having a number of pears, gave 8 of them to William, 12 to Charles, 9 to James, and had 1 left : how many had he at first ?

16. There are 3 bags of coffee in the closet ; the first contains 16 pounds, the second 14 pounds, and the third 7 pounds : how many pounds in all the bags ?

17. A farmer has sheep in 4 pastures ; in the first there are 3 sheep, in the second there are 6, in the third there are 7, and in the fourth there are 8 : how many are there in the four pastures ?

18. James gave 18 cents for a squirrel, 82 cents for a cage, and 15 cents for nuts : how much did he pay in all ?

19. A man bought a cow for 25 dollars, a calf for 5 dollars, 3 lambs for 8 dollars, and a pig for 2 dollars : what did he pay for all ?

20 A horse is worth 85 dollars, and a wagon 35 dollars : what is the value of both ?

21. A farmer gave 5 dollars for a sheep, 25 dollars for a cow, and 8 dollars for a calf : how much did he pay for all ?

22. Lucy bought a bonnet for 3 dollars, a silk dress for 19 dollars, and a shawl for 29 dollars : what did she pay for all ?

23 An orchard contains 15 cherry-trees, 37 plum-trees, and 45 apple-trees: how many trees are in the orchard?

24. Twenty-two years ago, Mr. Burton was 27 years old: how old is he now?

25. From Hyde Park, on the Hudson river, to Poughkeepsie, is 15 miles, and from Poughkeepsie to New York, 75 miles: how far from Hyde Park to New York?

26. James is 19 years old, John 20, and Charles 22: what is the sum of their ages?

27. A farmer bought a horse for 65 dollars, a saddle for 16 dollars, and a bridle for 9 dollars: what did he pay for all?

28. A lady paid 36 dollars for a carpet, 27 dollars for a sofa, and 20 dollars for an easy chair: what did she pay for all?

29. John hoes 19 rows of corn, James 31 rows, and William 48 rows: how many rows do they all hoe?

30. A woman is 45 years old, and her daughter 27: what is the sum of their ages?

31. A lady bought some tape for 10 cents, some pins for 18 cents, and a pair of scissors for 30 cents: how much did she pay in all?

32. A farmer has 15 sheep in one lot, 25 in another, and 30 in his barn-yard: how many has he in all?

33. A merchant buys 26 barrels of flour of one miller, 30 of another, and 36 of another: how many barrels does he buy in all?

34. A man bought a horse, saddle, and bridle; for the horse he gave 75 dollars, for the saddle 25 dollars, and 7 dollars for the bridle: what did they all cost him?

35. A farmer had a horse, for which he paid 85 dol-

lars.   He was willing to sell it, if he received 25 dollars more than he paid for it   What price did he ask for the horse ?

36. A boy bought a sled for 65 cents, and he was obliged to pay 18 cents for mending it, and 12 cents for painting it : what was the cost of the sled ?

37. John goes 5 miles in one direction, and James goes 7 miles from the same point, in an opposite direction: how far apart are they ?

38. Sing Sing is, by the Hudson River railroad, 43 miles south of Poughkeepsie, and Hudson is 41 miles north of it : how far apart are Hudson and Sing Sing ?

39. Robert bought an orange for 5 cents, gave 7 cents to a beggar, lost 8 cents, and had 9 cents left : how many cents had he at first ?

40. Father paid 9 shillings for cloth for James' jacket, 2 shillings for cutting it, 3 shillings for lining and buttons, and 4 shillings for the making : what did the jacket cost ?

41. I paid 45 dollars for a wagon : for what must I sell it, so as to gain 10 dollars ?

42. The monthly wages of a laborer are 10 dollars and his board. Supposing the board to be worth 12 dollars a month, what are the wages of the laborer ?

43. A grocer mixes 3 pounds of tea worth 12 shillings, with 4 pounds worth 20 shillings : how many pounds are there in the mixture, and what is it worth ?

44. A person sells 6 apples for 12 cents, and 9 others for 15 cents : how many apples does he sell, and what does he get for them ?

45. James and Robert had equal amounts of money in the morning ; during the day, James lost 6 dollars, and Robert gained 9 dollars. In the evening, who had the larger amount, and how much larger ?

SECTION SECOND.

LESSON I.

THE DIFFERENCE between two numbers, is that number which, added to the less, will give the greater.

1. William had six apples, and gave 4 to James: how many had he left?

ANALYSIS.—*He had left .the difference between* 6 *apples and* 4 *apples:* 2 *is the difference between* 6 *and* 4 *: Therefore, he had* 2 *apples left.*

2. James has 3 marbles, and gives them all to John: how many has he left?

3. Jane has 7 needles, and loses 5: how many has she left?

4. Henry has 8 pears in his basket, and gives 3 to his mother: how many has he left?

5. Lucy has 9 pins in her cushion, and takes 5 out: how many are left?

6. James has six squirrels in a cage, and takes them all out: how many are left?

7. Reuben has 8 plums, and gives seven to his sister Jane: how many has he left?

8. There are nine chairs in a room, and Mary takes out seven: how many are left?

9. Nancy had 10 birds in her cage, but left the door open, and 8 flew away: how many were left?

10. Julian had 12 peaches on his tree, and picked off 9 of them: how many were left?

11.   7 less 3, are how many?   9 less 3, are?

12.   12 less 3, are how many?   14 less 3, are?

13.	4 less 4, what remains?	8 less 4, are?
14.	15 less 4, are how many?	8 less 5, are?
15.	17 less 6, are how many?	17 less 7, are?
16.	12 less 7, are how many?	15 less 7, are?
17	14 less 8, are how many?	18 less 10, are?
18.	24 less 4, are how many?	29 less 9, are?
19.	10 less 6, are how many?	15 less 9, are?

20. The sign, —, is called *minus;* when placed between two numbers, it shows that the one on the right is to be taken from that on the left: thus, 8 − 3, shows that 3 must be taken from 8, and it is read, 8 minus 3

What is left, is called the *difference* or *remainder*, and may be placed on the right of the sign of equality; thus, 8 − 3 = 5. The expression is read, 8 minus 3 equals 5. The operation of taking one number from another, is called *Subtraction*.

21.	12 − 9, are how many?	15 − 9, are?
22.	19 − 9, are how many?	16 − 6, are?
23.	14 − 4, are how many?	25 − 5, are?
24.	30 − 7, are how many?	27 − 7, are?
25.	19 − 7, are how many?	14 − 8, are?
26.	15 − 3, are how many?	24 − 4, are?
27.	16 − 5, are how many?	17 − 8, are?
28.	19 − 7, are how many?	19 − 9, are?
29.	29 − 8, are how many?	34 − 3, are?
30.	35 − 6, are how many?	50 − 8, are?
31.	57 − 6, are how many?	59 − 5, are?
32.	53 − 7, are how many?	15 − 10, are?
53.	36 − 16, are how many?	25 − 12, are?
34.	20 − 14, are how many?	30 − 12, are?
35.	29 − 10, are how many?	39 − 20, are?
36.	42 − 12, are how many?	50 − 20, are?

37. There were 19 peach-trees in an orchard; 6 of them were blown down in a storm: how many were left standing?

38. Laura has 25 cents; if she buys an arithmetic for 18 cents, how much will she have left?

39. There are 34 pears in a basket; if 9 of them are taken out, how many will be left?

40. There were 65 pigeons in a flock; John fired at them, and killed 7: how many were left?

41. There are 54 sheep in a fold. If a wolf breaks in and kills 7, how many will be left?

42. There are 49 scholars in a school, and 10 of them are girls: how many boys are there?

43. In another school there are 20 scholars, and 9 are boys: how many girls are there?

44. In Elizabeth's flower-bed there were 30 beautiful lilies, and John broke off 7 of them: how many were unbroken?

45. James had 37 cents; he spent 7 for candy, and 8 for a pencil: how many had he left?

46. John had twenty-five cents, and spent 6 cents for a top and 9 cents for a pencil: how much had he left?

47. William had 37 cents; he bought a top for 10 cents, and 8 marbles for 2 cents: how much had he left?

48. A boy had 40 peaches; he gave 24 to Lucy, and 9 to Elizabeth: how many had he left?

49. James received a premium worth 56 cents; Jane received one worth 30 cents: what was the difference of their values?

50. Charles had 49 cents, and bought a book which cost him 29 cents: how much had he left?

51. A butcher bought 39 sheep, and killed 17: how many were left alive?

52. A grocer had a tub of butter containing 45 pounds ; he sold 20 pounds to Mr. Wilson, and 15 pounds to Mr. Jones : how much was left ?

53. Mr. Jones had 45 sheep in his pasture ; John left the bars down, and 23 ran away : how many were left ?

54. Mr. Squires paid 56 dollars for a horse, and 25 dollars for a cow : how much more did the horse cost him than the cow ?

55. Three men bought a horse for 56 dollars ; the first paid 16 dollars, and the second 20 dollars : what did the third pay ?

56. Charles bought a penknife for 48 cents, and a top for 25 cents : how much more did he pay for the knife than for the top ?

57. Mr. Jones bought a horse for 86 dollars, and sold it for 30 dollars : how much did he lose by the sale ?

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LESSON II.

1. John had 10 cents ; he gave 2 cents for a pencil, and 4 cents for an orange : how many cents had he left ?

ANALYSIS.—*John had left the difference between* 10 *cents and the sum of* 2 *cents and* 4 *cents : the sum of* 2 *and* 4 *is* 6, *and the difference between* 10 *and* 6 *is* 4 : *Therefore, John had* 4 *cents left.*

2. William has 25 cents, and buys a penknife for 16 cents and a pencil for 6 cents : how much has he left ?

3. Six and 4, less 3, are how many ?

4. Eight and 9, less 4, are how many ?

5. Seven and 5, less 3, are how many ?

6. Nine and 2, less 6, are how many?

7. Thirty and 5, less 10, are how many?

8. Twenty-one and 6, less 12, are how many?

9. Forty-five and 15, less 9, are how many?

10. Sixty-nine and 11, less 8, are how many?

11. Seventy-five and 5, less 8, are how many?

12. Forty-five and 8, less 12, are how many?

13. $24 + 2 - 3$, are how many?

14. $19 + 5 - 6$, are how many?

15. $30 + 45 - 12$, are how many?

16. $37 + 13 - 15$, are how many?

17. $45 + 15 - 10$, are how many?

18. $40 + 1 + 3 - 5$, are how many?

19. $37 + 3 + 10 - 8$, are how many?

20. $25 + 15 + 5 - 9$, are how many?

21. James had 40 cents, and paid 12 cents for a whistle and 25 cents for a knife: how much had he left?

22. James has 26 nuts in one pocket, and 14 less in the other pocket: how many has he in both?

23. A school-boy paid 56 cents for an Atlas, and 30 cents for an Arithmetic: how much more did he pay for the Atlas than for the Arithmetic?

24. A drover bought 40 sheep of three farmers; he bought 8 of the first, and 16 of the second: how many did he buy of the third?

25. Jane had 9 oranges, her mother gave her 7 more, and her father enough to make 40: how many did her father give her?

26. A man traveled 5 miles before breakfast, 19 miles between breakfast and dinner, and then went back 12 miles: how far was he then from the place of starting?

27. A cow is worth 25 dollars; she has a calf worth 3 dollars: how much more is the cow worth than the calf?

28. A grocer bought some lemons for 15 dollars, some oranges for 25 dollars, and then sold the whole for 56 dollars : how much did he make ?

29. Jane has 32 rose-buds on one bush, and 16 on another; 38, only, blossom: how many buds did not blossom?

30 William went after chestnuts ; he put 26 in one pocket, and 15 in another ; he lost 21 on his way home : how many had he left ?

31. Mr. Jones owes his grocer, baker, and butcher 50 dollars ; he owes his baker 27 dollars, and his grocer 16 dollars : how much does he owe his butcher ?

32. A farmer has 30 sheep in one pasture, 25 in another, and 15 in a third ; 2 sheep escape from the first pasture, 3 from the second, and 4 from the third : how many sheep were left ?

33. James and John start from the same point and travel in the same direction ; James goes 16 miles, and John goes 9 miles : how far apart will they be ?

34. If two men travel in the same direction, and from the same point, the one at the rate of 32 miles per hour, and the other of 24 miles per hour, how far apart will they be at the end of the hour ?

35 On May 6th, how many days yet remain in the month ?

36. How many days are there yet in December, on the 24th of that month ?

37. How many days from April 6th to the end of May ?

38. Allen was born 7 years before Joseph ; Allen is 18 years old : how old is Joseph ?

39. A father is 27 years older than his oldest son, and 36 years older than his youngest son : what is the difference in the ages of the sons ?

SECTION THIRD.

LESSON I.

1. If 1 orange costs 2 cents, what will 5 oranges cost?

2. If a laborer earns 6 dollars in a week, how much will he earn in 2 weeks?

3. James bought 4 lemons, at 3 cents apiece: how much did they cost him?

ANALYSIS.—*Four lemons will cost* 4 *times as much as* 1 *lemon:* 1 *lemon costs* 3 *cents: Therefore,* 4 *lemons will cost* 4 *times* 3 *cents, which are* 12 *cents.*

4. How much will 2 pineapples cost, at 8 cents apiece?

5. If 1 hat costs 8 dollars, what will 2 hats cost?

6. Two times 1, are how many?	1 time 2?
7. Two times 2, are how many?	2 times 2?
8. Two times 3, are how many?	3 times 2?
9. Two times 4, are how many?	4 times 2?
10. Two times 5, are how many?	5 times 2?
11. Two times 6, are how many?	6 times 2?
12. Two times 7, are how many?	7 times 2?
13. Two times 8, are how many?	8 times 2?
14. Two times 9, are how many?	9 times 2?
15. Two times 10, are how many?	10 times 2?
16. Two times 11, are how many?	11 times 2?
17. Two times 12, are how many?	12 times 2?

18. What is the cost of 3 oranges, at 1 cent apiece? At 2 cents? At 3 cents?

19. What is the cost of 3 yards of cloth, at 4 dollars a yard? At 5 dollars?

20. What is the cost of 3 pineapples, at 6 cents apiece? At 7 cents? At 8 cents?

21. Three times 1, are how many?   1 time 3?
22. Three times 2, are how many?   2 times 3?
23. Three times 3, are how many?   3 times 3?
24. Three times 4, are how many?   4 times 3?
25. Three times 5, are how many?   5 times 3?
26. Three times 6, are how many?   6 times 3?
27. Three times 7, are how many?   7 times 3?
28. Three times 8, are how many?   8 times 3?
29. Three times 9, are how many?   9 times 3?
30. Three times 10, are how many?   10 times 3?
31. Three times 11, are how many?   11 times 3?
32. Three times 12 are how many?   12 times 3?

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33. If a hat costs 3 dollars, how much will 4 hats cost? How much, if it costs 5 dollars?

34. What will four bunches of grapes cost, at 1 cent a bunch? At 2 cents? At 7 cents?

35. What will 4 pounds of raisins cost, at 8 cents a pound? At 9 cents? At 12 cents?

36. Four times 1, are how many?   1 time 4?
37. Four times 2, are how many?   2 times 4?
38. Four times 3, are how many?   3 times 4?
39. Four times 4, are how many?   4 times 4?
40. Four times 5, are how many?   5 times 4?
41. Four times 6, are how many?   6 times 4?
42. Four times 7, are how many?   7 times 4?
43. Four times 8, are how many?   8 times 4?
44. Four times 9, are how many?   9 times 4?
45. Four times 10, are how many?   10 times 4?

46   Four times 11, are how many?   11 times 4 ?
47   Four times 12, are how many?   12 times 4 ?

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48. What will 5 axes cost, at 1 dollar apiece?

49. What will 5 chairs cost, at 4 dollars apiece? What at 5 dollars?   At 6 dollars?

50. If a man, in selling a penknife, gains 10 cents, how much will he gain in selling 5 penknives?

51   Five times 1, are how many?   1 time 5 ?
52. Five times 2, are how many?   2 times 5 ?
53. Five times 3, are how many?   3 times 5 ?
54. Five times 4, are how many?   4 times 5 ?
55. Five times 5, are how many?   5 times 5 ?
56. Five times 6, are how many?   6 times 5 ?
57. Five times 7, are how many?   7 times 5 ?
58. Five times 8, are how many?   8 times 5 ?
59. Five times 9, are how many?   9 times 5 ?
60. Five times 10, are how many?   10 times 5 ?
61. Five times 11, are how many?   11 times 5 ?
62. Five times 12, are how many?   12 times 5 ?

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63. How far will a horse trot in 6 hours, if he trots 2 miles an hour?   If he trots 4 miles?   3 miles?

64. What will 6 yards of cloth cost at 5 dollars a yard?   At 7 dollars?   At 6 dollars?

65. What will 6 pair of boots cost, at 9 dollars a pair? At 10 dollars a pair?   At 8 dollars?

66. Six times 1, are how many?   1 time 6 ?
67. Six times 2, are how many?   2 times 6 ?
68. Six times 3, are how many?   3 times 6 ?
69. Six times 4, are how many?   4 times 6 ?
70. Six times 5, are how many?   5 times 6 ?
71. Six times 6, are how many? . 6 times 6 ?

72. Six times 7, are how many?   7 times 6?
73. Six times 8, are how many?   8 times 6?
74. Six times 9, are how many?   9 times 6?
75. Six times 10, are how many?   10 times 6?
76. Six times 11, are how many?   11 times 6?
77. Six times 12, are how many?   12 times 6?

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78. How much would a man earn in 7 days, if he earns 6 shillings a day? If he earns 5 shillings?

79. How many yards are required to make 7 cloaks, if 8 yards make 1 cloak? If 7 yards? If 9 yards?

80. How far will a sloop sail in 7 hours, if she sails 11 miles per hour? If 10 miles? If 12 miles?

81. Seven times 1, are how many?   1 time 7?
82. Seven times 2, are how many?   2 times 7?
83. Seven times 3, are how many?   3 times 7?
84. Seven times 4, are how many?   4 times 7?
85. Seven times 5, are how many?   5 times 7?
86. Seven times 6, are how many?   6 times 7?
87. Seven times 7, are how many?   7 times 7?
88. Seven times 8, are how many?   8 times 7?
89. Seven times 9, are how many?   9 times 7?
90. Seven times 10, are how many?   10 times 7?
91. Seven times 11, are how many?   11 times 7?
92. Seven times 12, are how many?   12 times 7?

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93. If one bench seats 6 children, how many will 8 benches seat? If 9 children? If 12?

94. A turkey cost 5 shillings, and was sold for 12 shillings: how much was gained? How much would be gained on 8 turkeys?

95. There are 12 inches in one foot: how many are there in 8 feet? How many are 8 times 10 dollars?

96.	Eight times 1, are how many?	1 time 8?
97.	Eight times 2, are how many?	2 times 8?
98.	Eight times 3, are how many?	3 times 8?
99.	Eight times 4, are how many?	4 times 8?
100	Eight times 5, are how many?	5 times 8?
101	Eight times 6, are how many?	6 times 8?
102.	Eight times 7, are how many?	7 times 8?
103.	Eight times 8, are how many?	8 times 8?
104	Eight times 9, are how many?	9 times 8?
105.	Eight times 10, are how many?	10 times 8?
106.	Eight times 11, are how many?	11 times 8?
107.	Eight times 12, are how many?	12 times 8?

108. How much will 9 rabbits cost, at 4 cents apiece?

109. A quart contains 8 gills: how many gills are there in 9 quarts?   How many are 9 times 10 pears?

110. How much must be paid for 9 loaves of bread, at 12 cents each?   At 6 cents?   At 11 cents?

111.	Nine times 1, are how many?	1 time 9?
112.	Nine times 2, are how many?	2 times 9?
113.	Nine times 3, are how many?	3 times 9?
114.	Nine times 4, are how many?	4 times 9?
115.	Nine times 5, are how many?	5 times 9?
116.	Nine times 6, are how many?	6 times 9?
117.	Nine times 7, are how many?	7 times 9?
118.	Nine times 8, are how many?	8 times 9?
119.	Nine times 9, are how many?	9 times 9?
120.	Nine times 10, are how many?	10 times 9?
121.	Nine times 11, are how many?	11 times 9?
122.	Nine times 12, are how many?	12 times 9?

123. What will 10 chairs cost, at 5 shillings apiece? At 7 shillings?   At 9 shillings?   At 6 shillings?

124. John bought a ball for 12 cents, and sold it for 20 cents: how much did he gain? How much would he gain in selling 10 balls in the same manner?

125. A dog, while chasing a fox, runs 11 miles an hour: how far does he run in 10 hours? If 12 miles, how far?

126. Ten times	1, are how many?	1 time 10?
127. Ten times	2, are how many?	2 times 10?
128. Ten times	3, are how many?	3 times 10?
129. Ten times	4, are how many?	4 times 10?
130. Ten times	5, are how many?	5 times 10?
131. Ten times	6, are how many?	6 times 10?
132. Ten times	7, are how many?	7 times 10?
133. Ten times	8, are how many?	8 times 10?
134. Ten times	9, are how many?	9 times 10?
135. Ten times	10, are how many?	10 times 10?
136. Ten times	11, are how many?	11 times 10?
137. Ten times	12, are how many?	12 times 10?

138. If a keg of water fills 7 pails, how many pails will 11 kegs fill? If it fills 5 pails, how many?

139. How much must be paid for a ride of 11 miles, at 6 cents a mile? At 10 cents? At 8 cents?

140. How many are 11 times 12 men? How many, 11 times 9 baskets? How many, 11 times 11 cents?

141. Eleven times	1, are how many?	1 time 11?
142. Eleven times	2, are how many?	2 times 11?
143. Eleven times	3, are how many?	3 times 11?
144. Eleven times	4, are how many?	4 times 11?
145. Eleven times	5, are how many?	5 times 11?
146. Eleven times	6, are how many?	6 times 11?
147. Eleven times	7, are how many?	7 times 11?
148. Eleven times	8, are how many?	8 times 11?

149. Eleven times 9, are how many?   9 times 11?
150. Eleven times 10, are how many?   10 times 11?
151 Eleven times 11, are how many?   11 times 11?
152. Eleven times 12, are how many?   12 times 11?

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153. How many dollars would a man gain in 12 months,
at 2 dollars a month?   At 4 dollars?   At 3 dollars?

154. How much would 12 hats cost, at 7 dollars
apiece?   At 5 dollars?   At 6 dollars?

155. If a carpenter cuts from a board 11 inches, 12
times, how many inches has he cut off?

156. Twelve times 1, are how many?   1 time 12?
157. Twelve times 2, are how many?   2 times 12?
158. Twelve times 3, are how many?   3 times 12?
159. Twelve times 4, are how many?   4 times 12?
160. Twelve times 5, are how many?   5 times 12?
161. Twelve times 6, are how many?   6 times 12?
162. Twelve times 7, are how many?   7 times 12?
163. Twelve times 8, are how many?   8 times 12?
164. Twelve times 9, are how many?   9 times 12?
165. Twelve times 10, are how many?   10 times 12?
166. Twelve times 11, are how many?   11 times 12?
167. Twelve times 12, are how many?   12 times 12?

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LESSON II.

1. What is the cost of 5 oranges, at 3 cents apiece?

ANALYSIS.—*Five oranges will cost 5 times as much
as 1 orange: 1 orange costs 3 cents: Therefore, 5
oranges will cost 5 times 3 cents, which are 15 cents.*

2. What is the cost of 5 yards of cloth, at 5 dollars a
yard?   At 8 dollars?   At 9 dollars?

3. If one barrel of fish costs 7 dollars, how much will 8 barrels cost? 10 barrels?

4. If in a pound of candles there are 8 candles, how many are there in 6 pounds? If 10, how many?

5. What is the cost of 4 pounds of raisins, at 10 cents a pound? At 12 cents? At 9 cents?

6. How much will 7 pounds of sugar cost, at 6 cents a pound? At 9 cents? At 12?

7. If one book costs 7 cents, how much will 8 books cost? 10 books? 6 books?

8. How much must be paid for 6 loaves of bread, at 9 cents apiece? At 12 cents? At 5 cents?

9. What is the cost of 4 hats, at 7 dollars apiece, and of 5 caps, at 2 dollars apiece?

10. What is the cost of 12 chickens, at 12 cents apiece?

11. What is the difference between the cost of 2 pencils, at 9 cents apiece, and 3 tops, at 4 cents apiece?

12. A person bought 8 yards of ribbon, at 8 cents a yard: what did she pay for the ribbon?

13. What is the cost of 8 yards of cloth, at 5 dollars a yard, and 12 yards of silk, at 2 dollars a yard?

14. What is the difference between the cost of 6 yards of cloth, at 4 dollars a yard, and of 4 yards, at 6 dollars a yard?

15. If a man travels at the rate of 4 miles an hour, how far will he travel in 5 hours?

16. If an orange is worth 4 apples, how many apples are 8 oranges worth?

17 If a barrel of potatoes contains 3 bushels, how much will 6 barrels contain? 11 barrels?

18. In a year there are 12 months: how many months are there in 7 years? In 9 years?

19. A mechanic earns 10 dollars a week, and pays for

his board and other expenses 6 dollars a week: how much does he save in 7 weeks?

20. A person bought 6 oranges, at 4 cents apiece, and 2 lemons, at 3 cents apiece: what did he pay for all?

21. How many cents must a boy have, that he may buy 8 apples, at 1 cent apiece, and 4 pears, at 2 cents apiece?

22. A farmer exchanged 12 sheep for lambs, at the rate of 4 lambs for 1 sheep: how many lambs did he receive?

23. If I buy 6 barrels of pork, at 11 dollars a barrel, and sell it for 86 dollars, how much do I gain?

24. What is the difference between the cost of 8 lemons, at 5 cents apiece, and that of 2 oranges, at 4 cents apiece?

25. What is the cost of 10 sticks of candy, at 2 cents apiece, and 4 pounds of raisins, at 11 cents a pound?

26. Suppose that 3 yards of cloth make a suit. If a tailor cuts off cloth enough for 12 suits, from a piece containing 42 yards, how much is left?

27. A piece of calico contains 37 yards. How much of it remains, if 4 dresses, each of 9 yards, are cut off?

28. A farmer bought 9 sheep, at 3 dollars apiece, and 4 calves, at 4 dollars apiece: how much more did he pay for the sheep than for the calves?

29. Mary has 6 rose-bushes, with 9 buds on each, and 3 geraniums, with 8 buds on each: how many buds are there in all?

30. If the fare, for one person, from New York to Washington is 8 dollars, what will it be for a family of 9 persons?

31. Two men start together from the same place, and travel in opposite directions; one at the rate of 4 miles

an hour, and the other of 5 : how far apart will they be, at the end of 3 hours ?

32. James and Joseph start together from the same place, and travel in the same direction; James at the rate of 5 miles an hour, and John at the rate of 3: how far apart will they be, at the end of 6 hours ?

33. A family consumes 12 pounds of meat in a day. Beef is 9 cents a pound, and mutton 6 : how much will be saved each day, by eating mutton instead of beef ?

34. A drover bought 3 sheep, at 4 dollars apiece, and gave in payment 2 calves, at 5 dollars apiece, and the rest in cash : how much money did he pay ?

35. A boy, having 6 companions, wishes to give to each 3 apples, which are worth 2 cents apiece : how much must he spend to buy the apples ?

36. A jeweler bought a watch for 55 dollars, and a chain for 15 dollars ; he gave the two for 10 barrels of flour, at 8 dollars a barrel : how much did the jeweler gain ?

37. Four boys bought a foot-ball for 75 cents ; John paid 20 cents, James 33 cents, and William 18 cents : how much did Reuben pay ?

38. If a traveler, starting from any point, travels 10 hours, at 4 miles per hour, and then returns at the rate of 5 miles per hour, for 3 hours ; how far is he then from the place of departure ?

39. James and Robert started from the same point, and traveled in the same direction. Robert started 3 hours before James, and walked 4 miles an hour ; James then started, and walked 3 miles an hour : how far apart will they be at the end of 6 hours from the time Robert started ?

40. If the stuff for a coat costs 5 dollars the cutting 1

dollar, and the making 2 dollars, what would be the cost of 7 coats of the same kind?

41. A horse was bought for 84 dollars, and after being kept for 5 weeks, at 3 dollars a week, was sold for 100 dollars: how much was gained?

42. A person bought 7 barrels of flour for 40 dollars: he sells them, so as to gain 2 dollars on each barrel: how much does he get for the flour?

43. A cartman bought a horse for 75 dollars, and kept him 6 weeks, and then sold him for 90 dollars. His board cost 2 dollars a week, and his labor brought the cartman 5 dollars a week. Did the cartman gain or lose, and how much?

44. Three times 26, are how many?

ANALYSIS.—*In* 26 *there are* 2 *tens and* 6 *units.* 3 *times* 2 *tens are* 6 *tens, or* 60 *units, and* 3 *times* 6 *units are* 18 *units, which added to* 60 *units make* 78 *units : Therefore,* 3 *times* 26 *are* 78.

45. How many are 4 times 18? 23? 25?

46. How many are 6 times 13? 32? 18?

47. James reads 13 verses of the Bible a day: how many verses does he read in a week?

48. What will 8 pounds of butter cost, at 14 cents a pound?

49. If a steamboat goes at the rate of 14 miles an hour, how far will it go in 6 hours?

50. If 16 yards of cloth will cover an office floor, how many yards will be required for 7 offices?

51. If a vessel sails 15 knots an hour, how many knots will it sail in 8 hours?

52. How many are 3 times 18, less 4?

53. How many are 4 times 13, less 6?

54. How many are 6 times 14, plus 6?

55. James has 9 oranges, Charles twice as many lacking 4, and Robert 5 times as many as Charles: how many has Robert?

56. If 9 men can do a piece of work in 3 days, how long will it take 1 man to do it?

ANALYSIS.—*Nine men, in 1 day, can do 9 times as much as 1 man, or 9 days' work: 9 men, in 3 days, can do 3 times as much as 9 men in 1 day, or 27 days' work: Therefore, 9 men, in 3 days, can do as much as 1 man in 27 days.*

57. If 6 men can do a piece of work in 3 days, how long would it take 1 man to do it?

58. If 3 men can do a piece of work in 4 days, how long will it take 1 man to do it?

59. How long will it take 1 man to do what 9 men can do in 8 days?

60. If 6 men can do a piece of work in 9 days, how many men would be required to do it in 1 day?

61. If 4 men can build a wall in 12 days, how many men can build it in 1 day?

62. How many men could build, in 1 day, such a barn as 7 men can build in 8 days?

63. If 8 men can earn 25 dollars in 6 days, how many men could earn the same in 1 day?

64. If a barrel of flour lasts a family of 6 persons 8 weeks, how long will it last one person?

65. Eight persons, in 9 weeks, consume a barrel of pork: how long would it last 1 person?

SECTION FOURTH.

LESSON I.

1. When a number is divided into 2 equal parts, each part is called, *one-half of the number.*

How many halves are there of a number?

What is one-half of 2 apples? What is one-half of 2?

2. What is one-half of 6? What is one-half of 8? What is one-half of 10?

3. When a number is divided into 3 equal parts, each part is called, *one-third of the number.*

How many thirds are there of a number?

4. If 6 apples be equally divided among 3 boys, how many will each have?

ANALYSIS.—*Each boy will have one-third of* 6 *apples; one-third of* 6, *is* 2: *Therefore, each boy will have* 2 *apples.*

What is one-third of 3 apples? What are 2 thirds of 3? What are 3 thirds?

What is one-third of 12? What are 2 thirds of 12? What are 3 thirds of 12?

What is one-third of 21 apples? What are 2 thirds of 21?

5. When a number is divided into 4 equal parts, each part is called, *one-fourth of the number.*

How many fourths are there of a number?

What is one-fourth of 4 pears? What are 2 fourths of 4? What are 3 fourths of 4? 4 fourths?

What are 2 fourths of 16? What are 3 fourths of 16? What are 4 fourths of 16?

6. When a number is divided into 5 equal parts, each part is called, *one-fifth of the number.*

How many fifths are there of a number?

What is one-fifth of 5 chairs? What are 3 fifths of 5? What are 2 fifths? 4 fifths?

What is one-fifth of 20? What are 3 fifths of 20? What are 2 fifths of 20? 4 fifths? 5 fifths?

7. When a number is divided into six equal parts, each part is called, *one-sixth of the number.*

How many sixths are there of a number?

What is one-sixth of 12? What are 2 sixths of 12?

What is one-sixth of 30? What are 3 sixths of 30? What are 6 sixths of 30? 2 sixths? 5 sixths?

8. When a number is divided into seven equal parts, each part is called, *one-seventh of the number.*

How many sevenths are there of a number?

What is one-seventh of 21? What are 2 sevenths of 21? 5 sevenths? 6 sevenths? 7 sevenths?

What is one-seventh of 35? What are 2 sevenths of 35? 3 sevenths? 5 sevenths?

9. When a number is divided into 8 equal parts, each part is called, *one-eighth of the number.*

How many eighths are there of a number?

What is one-eighth of 32? What are 2 eighths of 32? 3 eighths? 5 eighths? 7 eighths?

What is one-eighth of 64? What are 5 eighths of 64? 6 eighths? 7 eighths? 8 eighths?

10. When a number is divided into 9 equal parts, each part is called, *one-ninth of the number*

How many ninths are there of a number?

What is one-ninth of 27?   What are 3 ninths of 27?
What are 5 ninths of 27?   7 ninths?

What is one-ninth of 9?   What are 2 ninths of 9?
What are 4 ninths of 9?   7 ninths?   8 ninths?

11. When a number is divided into 10 equal parts, each
part is called, *one-tenth of the number.*

How many tenths are there of a number?

What is one-tenth of 30?   What are 4 tenths of 30?
What are 6 tenths of 30?   8 tenths?   9 tenths?

What are 3 tenths of 40?   What are 5 tenths of 40?
What are 8 tenths of 40?   9 tenths?

12. When a number is divided into 11 equal parts each
part is called, *one-eleventh of the number.*

How many elevenths are there of a number?

What is 1 eleventh of 33?   What are 3 elevenths
of 33?   4 elevenths?   7 elevenths?   9 elevenths?

What are 5 elevenths of 66?   What are 6 elevenths?
What are 8 elevenths of 66?   9 elevenths?

13. When a number is divided into 12 equal parts, each
part is called, *one-twelfth of the number.*

How many twelfths are there of a number?

What is one-twelfth of 48?   What are 3 twelfths
of 48?   5 twelfths?   7 twelfths?

What are 3 twelfths of 36?   What are 4 twelfths?
What are 6 twelfths?   9 twelfths?

What is one-twelfth of 12?   What is one-twelfth
of 24?   Of 36?   Of 96?   Of 120?   Of 144?

14 If the wages of a month are 45 dollars, what are
the wages of one-third of a month, at the same rate?

15. If a barrel of flour is valued at 8 dollars, what is
the value of one-fourth of a barrel?

16. How much will a man earn in one-sixth of a week, at 18 dollars a week?

17. If the rent of a room is 60 dollars a year, what is the rent of it for one-twelfth of the time?

18. Sixty bushels of oats last a number of horses for one month: how many bushels do they consume in one-fifth of the time?

19. At 32 cents a yard, how much would one-eighth of a yard of calico cost?

20. A person, who has 56 dollars, lays up one-fourth of his money, and spends the remainder: how much does he lay up, and how much does he spend?

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LESSON II.

1. How do you find one-half of a number? *Ans.* By dividing the number by 2.

If you have one-half of a number, how do you find the number? *Ans.* By multiplying the one-half by 2.

What number is that whose half is 1? What number is that whose half is 2? 5? 10? 12?

2. How do you find one-third of a number? *Ans.* By dividing the number by 3.

If you have one-third of a number, how do you find the number? *Ans.* By multiplying the one-third by 3.

What is the number whose third part is 1? What is the number whose third is 5? 8? 9? 10? 12?

3. How do you find one-fourth of a number? *Ans.* By dividing the number by 4.

If you have one-fourth of a number, how do you find the number? *Ans.* By multiplying the one-fourth by 4.

What is the number whose fourth part is 1? What is the number whose fourth part is 2? 5? 4? 10?

4. How do you find one-fifth of a number? *Ans.* By dividing the number by 5.

If you have one-fifth of a number, how do you find the number? *Ans.* By multiplying the one-fifth by 5.

What is the number whose fifth part is 1? What is the number whose fifth part is 3? 5? 9? 12?

5. How do you find one-sixth of a number? *Ans.* By dividing the number by 6.

If you have one-sixth of a number, how do you find the number? *Ans.* By multiplying the one-sixth by 6.

What is the number whose sixth part is 1? What is the number whose sixth part is 5? 6? 9? 11?

6. How do you find one-seventh of a number? *Ans.* By dividing the number by 7.

If you have one-seventh of a number, how do you find the number? *Ans.* By multiplying the one-seventh by 7.

What is the number whose seventh part is 1? What is the number whose seventh part is 4? 6? 9? 12?

7. How do you find one-eighth of a number? *Ans.* By dividing the number by 8.

If you have one-eighth of a number, how do you find the number? *Ans.* By multiplying the one-eighth by 8.

What is the number whose eighth part is 1? What is the number whose eighth part is 5? 7? 8? 11? 12?

8. How do you find one-ninth of a number? *Ans* By dividing the number by 9.

If you have one-ninth of a number, how do you find the number? *Ans.* By multiplying the one-ninth by 9.

What is the number whose ninth part is 1 ? What is the number whose ninth part is 4 ? 8 ? 9 ? 12 ?

9. How do you find one-tenth of a number ? *Ans.* By dividing the number by 10.

If you have one-tenth of a number, how do you find the number ? *Ans.* By multiplying the one-tenth by 10.

What is the number whose tenth part is 1 ? What is the number whose tenth part is 6 ? 8 ? 9 ? 11 ? 12 ?

10. How do you find the eleventh part of a number ? *Ans.* By dividing the number by 11.

If you have one-eleventh of a number, how do you find the number ? *Ans.* By multiplying the one-eleventh part by 11.

What is the number whose eleventh part is 1 ? What is the number whose eleventh part is 6 ? 9 ? 11 ? 12 ?

11. How do you find the twelfth part of a number ? *Ans.* By dividing the number by 12.

If you have one-twelfth of a number, how do you find the number ? *Ans.* By multiplying the one-twelfth part by 12.

What is the number whose twelfth part is 1 ? What is the number whose twelfth part is 7 ? 10 ?

12. If one-half of a barrel of flour costs 4 dollars, what will a barrel cost ?

13. If one-half of a pound of tea costs 40 cents, what will a pound cost ?

14. If one-third of a piece of cloth costs 4 dollars, what will the whole piece cost ?

15. If one-fourth the distance between two places is 20 miles, what is the distance ?

16. What is the value of a horse, if one-fifth of his value is 15 dollars ?

17. What is the value of a watch, if one-tenth of its value is 9 dollars?

18. How much must be paid for a book, if one-twelfth of its value is 12 cents?

19 If 2 dollars will pay for one-ninth of a barrel of flour, what will pay for the whole barrel?

20 How much will a trunk cost, if 3 dollars is one-eleventh of its value?

21. If four dollars is one-eighth of the value of a coat, what is its value?

22. Nine boys bought a football for 108 cents, each paying an equal amount: what part of the price did each pay? How many cents did each pay?

23. If one-twelfth of a fat ox is worth 11 dollars, what is the value of the ox?

24. If one-sixth of a piece of cloth is 3 yards, how many yards are there in the piece?

25. If, in a third of a week, a laborer can earn 2 dollars, how much can he earn in one week?

26. A man paid 11 dollars, which was one-eleventh of what he agreed to pay for a carpet: what was the price of the carpet?

27. A farm-laborer receives 12 dollars for one-twelfth of a year: how much would he receive a year?

28. Two dollars are the one-third of what? One-fourth of what? One-fifth of what? One-eighth?

LESSON III.

1. What is one-half of 2 apples? Of 4 apples?

How many apples are 2 apples, and one-half of 2 apples? 2 and one-half of 2, are how many?

How many apples are 4 apples, and one-half of 4 apples? 4 and one-half of 4, are how many?

How many are 6, and one-half of 6? 8 and one-half of 8, are how many?

Three times 2, and one-half of 2, are how many?
Six times 2, and one-half of 2, are how many?
Twelve times 2, and one-half of 2, are how many?

2. What is one-third of three apples? Of 6 apples?
What is one-third of 3? What are 2 thirds of 3?
Three and one-third of 3, are how many?
Three and 2 thirds of 3, are how many?
Three times 3, and 2 thirds of 3, are how many?
Four times 3, and 1 third of 3, are how many?

3. What is one-fourth of 4 apples? Of 8 apples?
What is one-fourth of 4? What are 2 fourths of 4?
Four and one-fourth of 4, are how many?
Two times 4, and 2 fourths of 4, are how many?
Three times 4, and 3 fourths of 4, are how many?
Five times 4, and 4 fourths of 4, are how many?

4. What is one-fifth of 5 apples? Of 15 apples?
What is one-fifth of 5? What are 2 fifths of 5?
Five and 3 fifths of 5, are how many?

5. What is one-sixth of 6 apples? Of 12 apples?
What is one-sixth of 6? What are 2 sixths of 6?
Six and 3 sixths of 6, are how many?
Three times 6, and 5 sixths of 6, are how many?

6. What is one-seventh of 7 apples? Of 21 apples?
What is one-seventh of 7? Of 21? Of 28?
Three times 7, and 4 sevenths of 7, are how many?
Six times 7, and 5 sevenths of 7, are how many?
Nine times 7, and 6 sevenths of 7, are how many?

7. What is one-eighth of 8 apples?   Of 32 apples?
What is one-eighth of 8?   Of 32?   Of 64?
Three times 8, and 2 eighths of 8, are how many?
Nine times 8, and 5 eighths of 8, are how many?
Ten times 8, and 8 eighths of 8, are how many?

8 What is one-ninth of 9 apples?   Of 45 apples?
What is one-ninth of 9?   Of 45?   Of 99?
Four times 9, and 6 ninths of 9, are how many?
Nine times 8, and 5 ninths of 9, are how many?
Twelve times 7, and 8 ninths of 9, are how many?

9. What is one-tenth of 10 apples?   Of 60 apples?
What is one-tenth of 10?   Of 60?   Of 90?
Five times 10, and 3 tenths of 10, are how many?
Eight times 6, and 8 tenths of 10, are how many?
Eleven times 8, and 9 tenths of 10, are how many?

10. What is one-eleventh of 11 apples?   Of 55 apples?
What is one-eleventh of 11?   Of 55?   Of 77?   Of 88?
Seven times 10, and 7 elevenths of 11, are how many?
Eight times 11, and 10 elevenths of 11, are how many?
Ten times 8, and 11 elevenths of 11, are how many?

11. What is one-twelfth of 12 apples?   Of 84 apples?
What is one-twelfth of 12?   Of 84?   Of 108?   Of 144?
Five times 12, and 9 twelfths of 12, are how many?
Ten times 12, and 10 twelfths of 12, are how many?
Twelve times 12, and 12 twelfths of 12, are how many?

12. What is the cost of 5 yards and a half of cloth,
at 2 dollars a yard?

13. What is the cost of 6 pounds and a half of coffee,
at 8 cents a pound?

14. What is the cost of 12 pounds and a half of rice,
at 4 cents a pound?

4*

15. What will 3 and 2 thirds yards of cloth cost, at 6 dollars a yard.

ANALYSIS.— Two-thirds of a yard will cost 2 *thirds as much as* 1 *yard, or* 4 *dollars ;* 3 *yards will cost* 18 *dollars :* 4 *dollars plus* 18 *dollars are* 22 *dollars. Therefore,* **the** *cost will be* 22 *dollars.*

16. What will three and 3 fourths barrels of cider cost, at 4 dollars a barrel ?

17. What will 5 and 1 fourth barrels of flour cost, at 8 dollars a barrel ?

18. What will 7 and 3 fifths yards of cloth cost, at 5 dollars a yard ?

19. What will 3 and 3 fourths dozen of lemons cost, at 20 cents a dozen ?

20. A man bought 8 and 2 sixths barrels of fish, at 12 dollars a barrel : what did he pay for the fish ?

21. At 6 dollars a yard, how much must be paid for 11 yards and five-sixths of a yard of cloth ?

22. If a gentleman pays 6 dollars a week for board, how much must he pay for 9 and one-half weeks' board ?

23. What is the cost of 3 hundredweight and 7 eighths of a hundredweight of sugar, at 8 dollars a hundredweight ?

24. If a vessel sails 12 miles an hour, how far will she sail in 4 hours and eleven-twelfths of an hour ?

25. A person bought 6 barrels and four-fifths of a barrel of flour, at 10 dollars a barrel, and paid for them with 10 yards of cloth, at 3 dollars a yard, and with cash : how much cash was paid ?

26. If 8 yards and four-sevenths of a yard of cloth, at 7 dollars a yard, are worth one-half as much as a horse, what is the value of the horse ?

27. James, Henry, and Rufus bought a boat for 60 dollars; James paid one-fifth of the price, Henry paid five-twelfths, and Rufus paid the remainder: how much did each pay?

28. Edward is 16 years old; his father is 3 and five-eighths times as old: how old is the father?

29. How many months are 6 years and three-fourths of a year?   8 years and five-sixths of a year?

30. If one-half of a barrel of flour costs 4 dollars, how much will two barrels cost?   3 barrels?

LESSON IV.

1. Six are how many times 2?

ANALYSIS.—*Six are as many times* 2, *as* 2 *is contained times in* 6: 2 *is contained in* 6, 3 *times: Therefore,* 6 *are* 3 *times* 2.

A FACTOR of a number, is any number that will exactly divide it. The product of all the factors, is equal to the number itself.

2. Four are how many times 2? What are the factors of 4?

3. Six are how many times 3?   How many times 2? What are the factors of 6?

4. Eight are how many times 4?   How many times 2? What are the factors of 8?

5. Nine are how many times 3?   What are the factors of 9?

6. Ten are how many times 5?   How many times 2? What are the factors of 10?

7. Twelve are how many times 6?   How many times

2 ? How many times 4 ? How many times 3 ? What are the factors of 12 ?

8. Fourteen are how many times 7 ? How many times 2 ? What are the factors of 14 ?

9. Fifteen are how many times 5 ? How many times 3 ? What are the factors of 15 ?

10. Sixteen are how many times 8 ? How many times 2 ? How many times 4 ? What are the factors of 16 ?

11. Eighteen are how many times 9 ? How many times 2 ? How many times 6 ? How many times 3 ? What are the factors of 18 ?

12. Twenty are how many times 2 ? How many times 10 ? How many times 5 ? How many times 4 ? What are the factors of 20 ?

13. Twenty-two are how many times 11 ? How many times 2 ?

14. Twenty-four are how many times 12 ? How many times 2 ? How many times 8 ? How many times 3 ?

15. Twenty-six are how many times 2 ? How many times 13 ? What are the factors of 26 ?

16. Twenty-seven are how many times 9 ? How many times 3 ? What are the factors of 27 ?

17. Twenty-eight are how many times 2 ? How many times 14 ? What are the factors of 28 ?

18. Thirty are how many times 2 ? How many times 3 ? How many times 5 ? How many times 6 ? What are the factors of 30 ?

19. Thirty-three are how many times 3 ? How many times 11 ?

20. Thirty-four are how many times 2 ? How many times 17 ?

21. Thirty-six are how many times 18 ? How many

times 12 ? How many times 9 ? How many times 6 ? How many times 4 ? How many times 3 ? How many times 2 ? What are the factors of 36 ?

22. Thirty-eight are how many times 19 ? How many times 2 ? What are the factors of 38 ?

23. Forty are how many times 20 ? How many times 10 ? How many times 8 ? How many times 5 ? How many times 4 ? How many times 2 ?

24. Forty-two are how many times 21 ? How many times 2 ? How many times 6 ? How many times 7 ? What are the factors of 42 ?

25. Forty-four are how many times 22 ? How many times 2 ? How many times 11 ? How many times 4 ? What are the factors of 44 ?

26. Forty-six are how many times 23 ? How many times 2 ? What are the factors of 46 ?

27. Forty-eight are how many times 24 ? How many times 16 ? How many times 12 ? How many times 8 ? How many times 6 ? How many times 4 ? How many times 3 ? How many times 2 ? What are the factors of 48 ?

28. Forty-nine are how many times 7 ? What are the factors of 49 ?

29. Fifty are how many times 25 ? How many times 10 ? How many times 5 ? What are the factors of 50 ?

30. Fifty-four are how many times 9 ? How many times 6 ? How many times 27 ? What are the factors of 54 ?

31. Fifty-six are how many times 7 ? How many times 8 ? How many times 28 ? What are the factors ?

32. Sixty are how many times 10 ? How many times 12 ? How many times 5 ? What are the factors ?

33. Sixty-four are how many times 8? How many times 16? How many times 4? What are the factors?

34. Seventy are how many times 7? How many times 10? What are the factors?

35. Seventy-two are how many times 8? How many times 9? What are the factors?

36. Eighty-four are how many times 12? How many times 7? What are the factors?

37. Ninety-six are how many times 12? How many times 8? What are the factors?

38. One hundred are how many times 10? How many times 20? How many times 2?

39. Twenty plus 8, are how many times 7? How many times 4?

40. Thirty less 6, are how many times 6? How many times 4?

41. Sixty less 5, are how many times 11?

42. Ninety plus 9, are how many times 11?

43. Eighty-seven plus 3, are how many times 10?

44. Forty-five plus 4, are how many times 7?

45. Sixty-nine plus 15, are how many times 12? How many times 7?

46. Six times 7, less 2, are how many times 10?

47. Forty, plus 4 times 6, are how many times 8?

48. Fifty, plus 3 times 4, plus 2, are how many times 8?

49. Five times 6, plus 4 times 9, are how many times 1?

50. Seven times 8, plus 4, are how many times 6?

51. Eight times 5, plus 5, are how many times 9?

52. Five times 11, less 5, are how many times 2?

53. Forty-six, less 3 times 2, are how many times 10?

54. Seven times 9, plus 3 times 4, are how many times 25?

55. Six times 4, less 3 times 4, are how many times 3?

LESSON V.

1. If 15 oranges be divided equally among 5 boys, how many oranges will each boy have?

ANALYSIS.—*Each boy will have one of the 5 equal parts of 15 oranges: one of the 5 equal parts of 15, is 3 : Therefore, each boy will have 3 oranges*

2. If twelve pounds of tea be divided equally among 4 persons, how many pounds will each have?

3. John has 12 apples, and wishes to divide them equally among 3 mates : how many must he give to each?

4. If a piece of cloth, worth 72 dollars, be cut into 9 equal pieces, what is each piece worth?

5. If six premiums, worth 3 dollars apiece, be distributed equally among 3 scholars, what will be the value of the share of each?

6. A farmer distributed 84 peaches among 12 boys : how many did he give to each?

7. There are 96 premiums to be distributed equally among the 8 best scholars of the class : how many will each have?

8. Eighty-one scholars are to be seated on 9 benches, each bench to contain the same number : how many will there be on each bench?

9. John had 40 marbles, and divided them equally among himself and 4 brothers : how many did he give to each?

10. If John hoes 32 rows of corn in a day, working 8 hours, how many rows does he hoe in 1 hour?

11. If an orchard contains 132 trees, standing in 12 equal rows, how many trees are there in each row?

12. In a school-room there are 64 scholars, and 8 benches; if equally distributed, how many scholars will sit on each bench?

13 If 9 barrels of flour cost 54 dollars, what will 1 barrel cost?

ANALYSIS.—*One barrel of flour will cost one-ninth as much as 9 barrels: one-ninth of 54 dollars is 6 dollars: Therefore, 1 barrel of flour will cost 6 dollars.*

14. If 12 oranges cost 48 cents, what will 1 orange cost?

15. If 9 pineapples cost 99 cents, what will 1 pineapple cost?

16. If 11 yards of cloth cost 66 dollars, how much is that a yard?

17. If 9 yards of ribbon cost 72 cents, how much is that a yard?

18. If a man travels 45 miles in 9 hours, how far does he travel in 1 hour?

19. If Willie gives 132 cents for 12 rabbits, how much is that apiece?

20. John bought 6 squirrels, for which he paid 66 cents: how much did he pay apiece?

21. A grocer bought 12 dozen of eggs, for which he paid 144 cents: how much did he pay a dozen?

22. If I travel 45 miles in 5 hours, how far do I travel in 1 hour?

23. Mr. Wilson buys 11 Merino sheep, for 88 dollars: how much is that apiece?

24. If a piece of cloth, containing 11 yards, costs 99 dollars, how much is that a yard?

25. James has 132 cents in his purse. If he divides them equally among himself and ten brothers, how many cents will he give to each?

26. If 49 dollars are equally divided among 7 boys, how many dollars will each have?

27. If 3 yards of cloth cost 15 dollars, how much will 7 yards cost?

ANALYSIS.—*One yard of cloth will cost one-third of 15 dollars, which is 5 dollars: 7 yards will cost 7 times as much as 1 yard: Therefore, 7 yards of cloth will cost 7 times 5 dollars, which are 35 dollars.*

28. If 7 oranges cost 21 cents, how much will 12 oranges cost?

29. If 9 yards of cloth cost 27 dollars, how much will 11 yards cost?

30. If 9 sheep cost 45 dollars, how much will 11 sheep cost?

31. If James can hoe 40 rows of corn in 5 days, how many rows can he hoe in 9 days?

32. If 15 pears cost 45 cents, what will 12 pears cost?

33. If I pay 96 dollars for 12 sheep, how much must I pay for 11 sheep?

34. If a man travels 48 miles in 6 hours, how far will he travel in 5 hours?

35. If a man travels 63 miles in 9 hours, how far will he travel in 11 hours?

36. If eighty-four dollars are paid for 12 barrels of cider, what will 9 barrels cost?

37. How much will 12 hats cost, if 7 of them cost 14 dollars?

38. How much will a person earn in 14 days, if he earns 48 dollars in 16 days?

39. What must John pay for 20 marbles, if 5 cost him 15 cents?

40. A farmer sold 14 sheep, at the rate of 2 sheep for 10 dollars: what did he receive for his sheep?

41. Lucy bought 6 yards of tape, for 18 cents: how much must she pay for 20 yards?

42. If John, at play, runs 6 miles in 2 hours, how far will he run in playing 5 hours?

43. Mr. Jones asked the cost of 90 yards of cloth, and was told that he could have 20 yards for 60 dollars: how much must he pay for 90 yards?

44. If Mr. Wilson got 27 dollars for 9 barrels of apples, how much, at the same price, would Mr. Jones get for 29 barrels?

45. If 16 quarts of milk cost 80 cents, what will 30 quarts cost?

46. If nine pounds of sugar cost 72 cents, what will be the cost of 25 pounds?

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LESSON VI

1. If 6 men can do a piece of work in 1 day, how many men could do it in 3 days?

ANALYSIS.—6 *men, in 1 day, can do as much as 1 man in 6 days, or 6 days' work. To do the work in 3 days will require as many men as 3 is contained times in 6, which is 2 times: Therefore, to do the work in 3 days will require 2 men.*

2. How many men could do in 9 days what 18 men can do in 1 day?

3. How many men can earn the same money in 11 days, that 77 men earn in 1 day?

4. If 72 men can build a wall in 1 day, how many men can build it in 12 days?

5. If 21 men can dig a ditch in 1 day, in how many days can 7 men dig it?

6. If a certain quantity of provisions will subsist a family of 18 persons for 1 day, how many persons would it subsist for 6 days?

7. If 30 loaves of bread would supply 27 persons for 1 day, how many persons would they supply for 9 days?

8. If 1 man can do a piece of work in 16 days, in what time can 4 men do the same work?

ANALYSIS.—*Since 4 men can do 4 times as much work as 1 man, in 1 day, 4 men can do the work in one-fourth of the time that 1 man can do it: one-fourth of 16 days is 4 days: Therefore, 4 men can do the work in 4 days.*

9. If one man can build a wall in 18 days, in what time can 6 men build the same wall?

10. If 2 men can construct an engine in 15 months, in what time could 6 men construct it?

11. In what time can 9 men earn as much money as one man can earn in 36 months?

12. If 1 man can build a house in 24 days, how long would it take 6 men to do it?

13. If one man can build a vessel in 30 months, in what time can 3 men build it?

14. If 9 men can do a piece of work in 16 days, in how many days will 12 men do the work?

15. How long would it take 8 men to do what 12 men would do in 6 days?

16. If 3 men can do a piece of work in 12 days, how long will it take 9 men to do the same work?

ANALYSIS.—*If 3 men can do a piece of work in 12 days, it will take 1 man 3 times 12 days, which is 36 days. If 1 man can do the work in 36 days, it will take 9 men one-ninth of 36 days, which is 4 days: Therefore, 9 men can do the work in 4 days.*

17. If 2 men can build a wall in 12 days, how many days will it take 6 men to do it?

18. In how many days can 8 men do as much work as 12 men can do in 6 days?

19. In how many days can 5 men do as much work as 15 men can do in 3 days?

20. If 20 loaves of bread will last a family of 5 persons six days, how long will they last a family of 3 persons?

21. If 16 horses eat a certain quantity of hay in 6 days, how many horses will the same hay feed for 12 days?

22. If 6 men can earn 42 dollars in 8 days, how long would it take 12 men to earn the same?

23. In what time could eight men earn as much as 4 men can in 10 days?

24. How many men can, in 5 days, earn as much as 10 men can in 4 days?

25. If 8 men can build a wall in 12 days, in what time could 6 men build it?

26. In how many days could 9 men build a wall, if 6 men could do it in 12 days?

27. If a barrel of flour would last a family of 9 persons 6 weeks, how long would it last a family of 3 persons?

28. If 100 dollars will support a family of 7 persons for 8 weeks, how many persons would it support for 4 weeks?

29. A merchant bought 8 yards of cloth, at 2 dollars a yard, and 4 yards at 5 dollars a yard: what will each yard bring him, if he sells both kinds at the same price?

30. A person bought an orange for 3 cents, a lemon for 2 cents, a pineapple for 13 cents, and a cocoa-nut for 10 cents; he sold them all at an equal price, and received the same amount as he paid: what was the common price?

LESSON VII.

1. One-half of 8, is one-third of what number?

ANALYSIS.—*One-half of 8 is 4: since 4 is one-third of the number, the number itself must be 3 times 4, which is 12: Therefore, one-half of 8, is one-third of 12.*

2. One-half of 8, is one-fourth of what number?
3. One-third of 6, is one-fifth of what number?
4. One-fourth of 4, is one-third of what number?
5. One-fifth of 10, is one-sixth of what number?
6. One-fourth of 8, is one-seventh of what number?
7. One-sixth of 12, is one-ninth of what number?
8. Twelve is one-fifth of what number?
9. One-eighth of 72, is one-twelfth of what number?
10. One-tenth of 100, is one-ninth of what number?
11. One-eleventh of 33, is one-twelfth of what number?
12. One-fourth of 36, is one-ninth of what number?
13. One-sixth of 60, is one-twelfth of what number?
14. One-fifth of 20, is how many times 2?
15. One-eighth of 64, is how many times 4?
16 One-twelfth of 72, is how many times 3?
17 One-tenth of 50, is how many times 1?
18. One-ninth of 27, is one-twelfth of what number?

19. One-sixth of 42, is one-seventh of what number?
20. One-ninth of 72, is one-sixth of what number?
21 One-twelfth of 144, is one-eleventh of what number?

22. One-third of 36, is 4 times what number?

ANALYSIS.—*One-third of* 36 *is* 12: *since* 12 *is* 4 *times the required number, that number must be one-fourth of* 12, *which is* 3: *Therefore, one-third of* 36, *is* 4 *times* 3.

23. One-fourth of 8, is 2 times what number?
24. One-sixth of 54, is 3 times what number?
25 One-fourth of 100, is 5 times what number?
26. One-half of 36, is 9 times what number?
27. One-tenth of 60, is 6 times what number?
28. One-seventh of 84, is 2 times what number?
29. One-ninth of 108, is 12 times what number?
30. One-third of 60, is 4 times what number?
31. One-sixth of 96, is 8 times what number?
32. One-fourth of 44, is 11 times what number?
33. One-eighth of 96, is 3 times what number?
34. One-sixth of 72, is 12 times what number.?
35. One-seventh of 63, is 3 times what number?
36. One-eleventh of 132, is 2 times what number?
37. One-sixth of 72, is 3 times what number?
38. One-third of 60, is 10 times what number?
39. One-seventh of 49, is 7 times what number?
40. Three-sevenths of 21, are one-half of what number?
41. Four-sixths of 24, are one-third of what number?
42. Three-eighths of 24, are one-fourth of what number.
43. Five-tenths of 20, are one-fifth of what number?
44. Nine-twelfths of 36, are one-half of what number?
45. Eight-ninths of 72 are 8 times what number?
46. Six-eighths of 24, are how many times 9?

47. Eleven-twelfths of 36, are how many times 11 ?

48. Five-ninths of 72, are how many times 4 ?

49. Seven-eighths of 64, are how many times 2 ?

50. Four-fifths of 30, are how many times 8 ?

51. Nine-tenths of 50, are how many times 3 ?

52 Four-twelfths of 48, are how many times 8 ?

53 Six-sevenths of 84, are how many times 12 ?

54. Eight-ninths of 81, are how many times 8 ?

55. Ten-elevenths of 33, are how many times 15 ?

56. Five-fourths of 32, are how many times 1 ?   2 ?

57. Eleven-twelfths of 60, are how many times 5 ?

58. Twelve-twelfths of 144, are how many times 8 ?

LESSON VIII

1. At 3 cents apiece, how many oranges can be bought for 15 cents ?

ANALYSIS.—*Since 3 cents will pay for 1 orange, 15 cents will pay for as many oranges as 3 is contained times in 15: 3 in 15, 5 times: Therefore, at 3 cents apiece, 5 oranges will cost 15 cents.*

2. At 2 cents apiece, how many lemons can be bought for 28 cents ?

3. A farmer has 36 dollars to lay out in sheep; he can get them at 3 dollars a head : how many can he buy ?

4. If 6 sheets of paper make a copy-book, how many copy-books will 72 sheets make ?

5. If one yard of broadcloth costs 6 dollars, how many yards can be bought for 30 dollars ?   For 48 ?

6. If a man travels 6 miles in 1 hour, how long will it take him to travel 42 miles ?   72 miles ?

7. If a yard of ribbon costs 7 cents, how many yards can be bought for 56 cents? For 84 cents?

8. For 96 dollars, how many yards of cloth can you buy, at 8 dollars a yard?

9. A laborer engaged to work for 12 dollars a month; at the end of the time he received 108 dollars: how many months had he worked?

10. A man has 84 pounds of butter, and can pack 12 pounds in a jar: how many jars does he need?

11. A lady paid 132 cents for ribbon, each yard costing 11 cents: how many yards did she buy?

12. A farmer sold 6 barrels of flour, at 5 dollars a barrel, and took his pay in cloth, at 3 dollars a yard: how many yards of cloth should he receive?

ANALYSIS.—*Six barrels of flour, at 5 dollars a barrel, will cost 30 dollars: for 30 dollars, he should receive as many yards of cloth, as 3 dollars (the price of 1 yard) are contained times in 30 dollars, which are 10 : Therefore, he should receive 10 yards of cloth.*

13. How much honey, at 12 cents a pound, must be given for 6 pounds of coffee, at 16 cents a pound?

14. How many hats, at 4 dollars apiece, must be given for 12 yards of cloth, at 5 dollars a yard?

15. How many oranges, at 4 cents apiece, can be bought for 16 lemons, at 3 cents apiece?

16. A farmer has 4 dozen of eggs, worth 12 cents a dozen, and wishes to exchange them for nutmegs, worth 3 cents apiece: how many nutmegs should he receive?

17. A merchant gave 12 boxes of lemons for 2 firkins of butter, worth 18 dollars a firkin: what was the price of the lemons per box?

18. An employer owed his laborer 3 months' wages, at 12 dollars a month; he agreed to pay him 18 dollars in cash, and 3 barrels of flour: what was the cost of the flour to the laborer?

19. A farmer agreed to take 10 yards of cloth, at 4 dollars a yard, in payment for 8 calves: what did the farmer receive apiece for the calves?

20. How much cloth, at 2 dollars a yard, can be purchased for 30 bushels of wheat, at 1 dollar a bushel?

21. How many pineapples, at 9 cents apiece, can be bought for 27 oranges, at 4 cents apiece?

22. How many chickens, at 2 shillings apiece, will pay for 9 turkeys, at 8 shillings apiece?

23. How many pigs, at 4 shillings apiece, will pay for 9 yards of cloth, at 12 shillings a yard?

24. What is the cost of 48 lemons, at the rate of 3 lemons for 5 cents?

ANALYSIS.—*Since* 3 *lemons cost* 5 *cents,* 48 *lemons cost as many times* 5 *cents as* 3 *lemons are contained times in* 48 *lemons, which are* 16 *times:* 16 *times* 5 *cents are* 80 *cents: Therefore,* 48 *lemons, at* 3 *for* 5 *cents, cost* 80 *cents.*

25. What is the cost of 45 oranges, at the rate of 9 for 5 cents?

26. What is the cost of 36 lemons, at the rate of 3 for 7 cents?

27. How many melons, at 9 cents each, must be given for 54 oranges, at the rate of 3 oranges for 4 cents?

28. How many peaches, at 1 cent apiece, must be given for 16 pineapples, at the rate of 4 for 16 cents?

29. If 7 melons can be bought for 15 cents, what will be the cost of 35 melons?

30. If 9 pineapples will buy 36 oranges, and 4 oranges will buy 1 cocoa-nut, how many cocoa-nuts will 3 pineapples buy?

31. What is the cost of 36 chickens, if 12 chickens cost 15 shillings?

32 How many dozen of eggs, at 8 cents a dozen, must be given for 32 oranges, at the rate of 12 cents for 3?

33. If 9 lemons are worth 11 cents, how many oranges, at 3 cents apiece, can be bought for 54 lemons?

34. If 6 pounds of butter are worth 13 shillings, how many yards of calico, at 2 shillings a yard, can be bought for 24 pounds?

LESSON IX.

PROMISCUOUS QUESTIONS.

1. A father divides 48 cents, equally, among 4 children: how many cents more will be necessary, to give an equal amount to 6 others?

2. If a steamboat runs 44 miles in 4 hours, how far will she run in 12 hours?

3. If 9 ladies' hats cost 108 dollars, what will 7 hats cost, at the same rate?

4. Mrs. Smirks bought 9 pair of shoes, for 18 dollars: how many pair could she buy for 54 dollars, at the same rate?

5. If a dog, pursuing a fox, runs 24 miles in 3 hours, how far would he run, at the same rate, in 5 hours?

6. A laborer earned 9 shillings on Monday, 12 shillings on Tuesday, 15 shillings on Wednesday, and 8 shillings on Thursday: what must he have received a day, had his

wages been the same every day, in order to earn the same amount ?

7 John has 24 marbles, Robert has 20, and Thomas has 16 : suppose they were equally divided among the boys, how many would each receive ?

8. Charles bought 15 peaches, at the rate of 5 for 9 cents, and paid for them in pineapples, at 9 cents apiece : how many pineapples did it require ?

9. A sailor bought 12 barrels of flour, at the rate of 2 barrels for 11 dollars, and paid in cloth, at 3 dollars a yard : how many yards did he give ?

10. Charles had 9 oranges, worth 4 cents apiece, and James 2 pineapples, worth 10 cents apiece ; James gave his pineapples for their value in oranges : how many oranges had Charles left ?

11. How many dozen of eggs, at 10 cents a dozen, must be given for 32 oranges, at the rate of 5 cents for 8 ?

12. If 8 pears are worth 12 cents, how many oranges, at 3 cents apiece, can be bought for 54 pears ?

13. If 9 pounds of butter are worth 18 shillings, how many yards of muslin, at 2 shillings a yard, can be bought for 24 pounds of butter ?

14. How many calves, worth 3 dollars apiece, must be given for 12 sheep, if 5 sheep cost 20 dollars ?

. 15. Two persons are 96 miles apart, and are traveling toward each other, one at the rate of 5 miles an hour, and the other at the rate of 3 miles an hour : in how many hours will they meet ?

16. Two persons are 10 miles apart, and travel in the same direction, the forward one at the rate of 5 miles an hour, and the other at the rate of 7 miles : how long before they will be together ?

17. A telegraphic wire is to be laid across a bay 30

miles wide. Two vessels, one sailing at the rate of 2 miles an hour, and the other at the rate of 3 miles an hour, start from such a point that, sailing in opposite directions, each shall reach the shore at the same time: how long will they be in dropping the wire?

18. If two vessels, having left port at the same time, sail in the same direction, one at the rate of 8 miles an hour, and the other of 13 miles an hour, in what time will they be 80 miles apart?

19. A fox is 60 rods ahead of a greyhound, but the greyhound runs 25 rods a minute, while the fox runs 20 rods: in how many minutes will the hound overtake the fox?

20. A horse-thief has 6 hours the start of the sheriff, and travels at the rate of 10 miles an hour; the sheriff, by taking a railroad, travels 25 miles an hour: how long before he will overtake the thief?

21. A steam vessel of war chased a piratical vessel, which was 12 miles ahead, and sailed at the rate of 12 miles an hour; the war vessel sailed at the rate of 15 miles an hour: in what time would it overtake the pirate, supposing that, during the chase, it lost an hour by an accident to its machinery?

22. A general, with his army, reached a bridge just in time to see it in flames, and the enemy safe on the other side, who retreated at the rate of 16 miles a day. It took 4 days to repair the bridge. The general then pursued, at the rate of 24 miles a day: how many days, before he overtakes the enemy?

25. A factory has two steam-engines, which are necessary to drive the machinery; the one requires 4 tons of coal per month, and the other 8 tons: how long would a cargo of 168 tons last the two engines?

24. John has 36 apples in his basket; five-ninths of them are one-seventh of the apples which Charles has: how many apples has Charles?

25. William has 2 hens, with 12 chickens each: these chickens are equal to one-eighth of James' chickens, which are equally divided between three hens: how many chickens has each of James' hens?

26. How many posts will be required for a fence of 100 feet in length, if the posts are to be 10 feet apart?

27. How many hills of corn, 3 feet apart, may be planted in a row that is 150 feet long?

28. How many lines of partition will be required in a stable that is 96 feet deep, so as to allow 4 feet of space for each stall?

29. A lecture-room is 72 feet in depth, and is to be seated with parallel rows of seats. There is to be a space of 4 feet from the wall to the back of the first row of seats, and an equal distance between each row: how many rows of seats can be placed in the room?

30. A plot of ground is 40 feet long and 30 feet wide. I wish to plant it with dwarf pear-trees, in equal parallel rows, so that the trees in the rows shall be 4 feet apart, and the rows 6 feet apart. Now, if the first row be placed on the longer edge of the plot, and have its first tree in a corner, how many trees will there be in the plot?
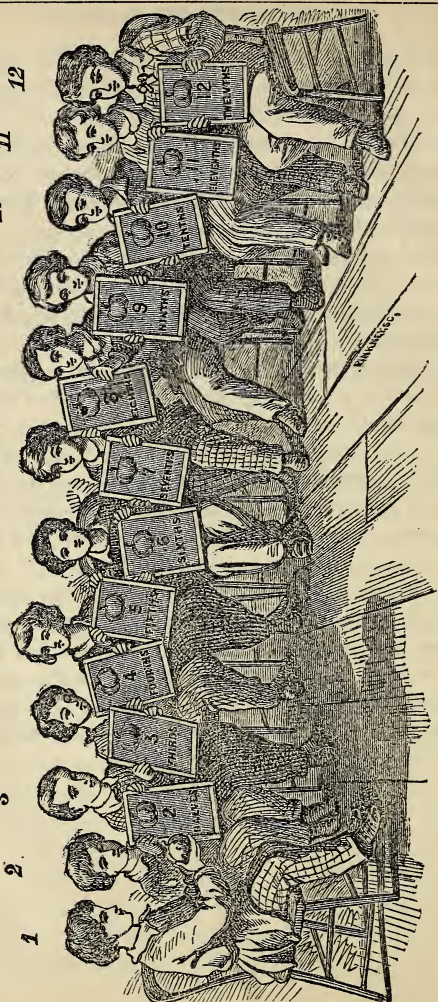
5*

SECTION FIFTH.

LESSON I.

1. Let us suppose that each boy, in a class of 12, has an apple of exactly the same size, and that the first boy holds his apple in his hand.

2. Suppose the second boy to divide his apple into 2 equal parts: he has then the whole apple, in 2 equal parts: each part is called, *one-half;* and the two parts, *two-halves*

3. Suppose the third boy to divide his apple into 3 equal parts: he has then the whole apple, in 3 equal parts: each part is called, *one-third;* two of the parts, *two-thirds;* and the 3 parts, *three-thirds.*

4. Suppose the fourth boy to divide his apple into 4 equal parts: he has then the whole apple, in 4 equal parts: each of the parts is called, *one-fourth;* 2 of them, 2 *fourths;* 3 of them, 3 *fourths;* and the four, *four-fourths.*

5. Suppose each boy of the class to divide his apple into as many equal parts as are denoted by his number: each part will take a name corresponding to that number. Thus, if the eighth boy divide his apple into 8 equal parts, he will have the whole apple, in 8 equal parts: each part is called, *one-eighth;* 2 of them, 2 *eighths;* 3 of them, 3 *eighths,* &c.

6. In the diagram, the place of each boy is numbered from 1 to 12, inclusive. His apple, and the number of equal parts into which it is divided, are marked on the slate which he holds in his hand.

7. The apple is called, the *Unit ;* and any equal part of it is called, a *fractional unit.* Thus, the first fractional unit is one-half of the apple ; the second, one-third of the apple ; the third, one-fourth of the apple, and so on

These fractional units are thus expressed in figures :

$\frac{1}{2}$	expresses	one-half of the unit
$\frac{1}{3}$	"	one-third of the unit.
$\frac{1}{4}$	"	one-fourth of the unit.
$\frac{1}{5}$	"	one-fifth of the unit.
&c.,		&c.

Two or more fractional units may be expressed by writing the number of them in the place of 1: thus,

$\frac{2}{3}$	expresses	2 thirds.
$\frac{5}{4}$	"	5 fourths.
$\frac{7}{9}$	"	7 ninths.
$\frac{12}{14}$	"	12 fourteenths
&c.,		&c.

8 A *fraction* is a fractional unit, or a collection of fractional units.

Every fraction may be expressed by two numbers, written one above the other, with a line between them.

The number written below the line is called, the *denominator.* It shows into how many equal parts the unit of the fraction is divided.

The number written above the line is called, the *numerator.* It shows how many fractional units are taken.

The numerator and denominator, taken together, are called, the *terms* of the fraction.

Three ideas are connected with every fraction : 1st, The unit divided ; 2d, Into how many equal parts the unit is divided ; 3d, How many such parts are taken.

9. Since every fraction is either a fractional unit, or a collection of fractional units, it has two factors:

$\frac{4}{5} = \frac{1}{5} \times 4$; in which the factors are $\frac{1}{5}$ and 4.

$\frac{7}{9} = \frac{1}{9} \times 7$; in which the factors are $\frac{1}{9}$ and 7.

$\frac{11}{12} = \frac{1}{12} \times 11$; in which the factors are $\frac{1}{12}$ and 11.

What are the factors of $\frac{7}{8}$? Of $\frac{9}{11}$? Of $\frac{6}{17}$?

What are the factors of $\frac{3}{16}$? Of $\frac{16}{15}$? Of $\frac{17}{21}$? Of $\frac{25}{29}$?

10. What is the unit of the fractions, in the example of the boys in the class? Name the fractional unit of the apple of each boy. What are all the fractional units of 1, as far as 20? What is the fractional unit corresponding to the number 16? To 30? To 45? To 60?

11. How many halves are there in 1? How many thirds? Into how many fourths may a unit be divided? How many fifths are equal to one unit? How many sixths? How many twelfths? How many eighths of a dollar in a dollar? How many tenths of a mile in a mile? How much do $\frac{3}{4}$ lack of 1? How much do $\frac{5}{9}$ lack of 1? How many twentieths must be added to $\frac{11}{20}$, to make it equal to 1? Take $\frac{4}{7}$ from 1, and what is left? Take $\frac{7}{11}$ from 1, and what is left? If the ninth boy were to give away 6 parts of his apple, what would he then have?

Which is the greater, one-half or one-third?

Which is the greater, one-sixth or one-fifth?

Which is the greater, one-ninth or one-twelfth?

LESSON II.

1. From every fractional unit, others of less value may be derived.

2. If the second boy cuts each half of his apple into 2

equal parts, he will have 4 equal parts—the same as the 4th boy. If he cuts each half into 4 equal parts, he will have 8 equal parts—the same as the 8th boy; and so on.

3. If the third boy cuts each third of his apple into 2 equal parts, he will have 6 equal parts—the same as the 6th boy. If he cuts each third into 3 equal parts, he will have 9 equal parts—the same as the 9th boy. If he cuts each third into 4 equal parts, he will have 12 equal parts—the same as the twelfth boy. Similar divisions may be made of the parts of each boy; and, also, for numbers greater than 12. ·

4. If the fourth boy divides each part of his apple into 2 equal parts, how many parts will he then have? How many, if he divides each part into 3 equal parts?

5. If the seventh boy divides each part of his apple into 2 equal parts, how many equal parts will he then have? What is each part called? If he divides each part into 4 equal parts, how many parts will he then have?

6. How may 5 ninths of an apple be derived from 1 apple? *Ans.* By taking 5 of the equal parts of the apple of the ninth boy. How else? *Ans.* By taking one of the parts from the third boy, dividing it into 3 equal parts, and taking 5 such parts.

7. In how many ways may 7 twelfths be derived from the unit 1 apple?

1st. By taking 7 of the equal parts of the apple of the twelfth boy.

2d. By taking 1 of the parts from the second boy, dividing it into 6 equal parts, and taking 7 such parts.

3d. By taking 1 of the parts from the fourth boy, dividing it into 3 equal parts, and taking 7 such parts.

4th. By taking one of the parts from the sixth boy dividing it into 2 equal parts, and taking 7 such parts.

How may $\frac{3}{14}$ be derived from the unit 1? In how many ways can $\frac{6}{15}$ be derived from 1? How can $\frac{9}{24}$ be derived from 1? How can $\frac{9}{30}$ be derived from 1?

The teacher may multiply these examples to any extent; and thus explain *all the ways* in which any given fraction may be derived from the unit 1.

8. In $\frac{1}{2}$, how many fourths? How many sixths? How many eighths? How many fourteenths? How many twentieths?

9. In $\frac{1}{3}$, how many sixths? How many ninths? How many fifteenths? How many twenty-fourths? How many forty-eighths?

10. In $\frac{1}{4}$, how many sixteenths? How many fortieths? How many forty-eighths? How many sixty-fourths? How many eightieths? How many hundredths? How many twelfths?

11. In $\frac{1}{5}$, how many tenths? How many twenty-fifths? How many thirtieths? How many fortieths? How many fiftieths?

12. In $\frac{1}{6}$, how many thirty-sixths? How many forty-eighths? How many twenty-fourths? How many fifty-fourths? How many eighteenths?

$\frac{1}{9}$ = how many eighteenths? How many 36ths?

$\frac{1}{7}$ = how many twenty-firsts? How many 28ths?

$\frac{1}{10}$ = how many twentieths? How many thirtieths?

$\frac{1}{12}$ = how many twenty-fourths? How many 36ths?

$\frac{1}{15}$ = how many thirtieths? How many sixtieths?

$\frac{1}{2}$ = how many fortieths? $\frac{1}{11}$ = how many 22ds?

$\frac{1}{16}$ = how many forty-eighths? To how many 32ds?

$\frac{1}{8}$ = how many sixty-fourths? How many 48ths?

$\frac{1}{5}$ = how many tenths? How many sixtieths?

$\frac{1}{13}$ = how many thirty-ninths? How many 65ths?

$\frac{1}{14}$ = how many forty-seconds? How many 70ths?

LESSON III.

1. A *proper fraction* is one in which the numerator is less than the denominator; as, $\frac{3}{4}$.

2. An *improper fraction* is one in which the numerator is equal to, or exceeds the denominator; as, $\frac{5}{5}$, or $\frac{7}{5}$.

3. A *mixed number* is composed of a whole number and a fraction; as, $6\frac{1}{5}$.

4. A *compound fraction* is the fraction of a fraction; as, $\frac{1}{2}$ of $\frac{1}{4}$.

5. How many halves are there in 1? How many in 2?

6. How many thirds of 1 are there in 4?

ANALYSIS.—*There are 4 times as many thirds in 4 as in 1: in 1 there are 3 thirds: Therefore, in 4, there are 4 times 3 thirds, which are 12 thirds.*

7. How many thirds of 1, in 3? In 2? In 6?
8. In 2, how many fourths? In 5? In 8? In 4?
9. How many fifths in 3? In 7? In 5? In 8?
10. In 4, how many sixths? In 3? In 7? In 5?
11. How many sevenths of 1, in 5? In 7? In 4?
12. How many eighths of 1, in 3? In 6? In 12?
13. How many tenths in 6? In 8? In 5? In 10?
14. How many twelfths in 2? In 5? In 9? In 4?
15. How many ninths in 7? In 3? In 8? In 6?
16. In 9, how many elevenths of 1? In 11? In 9?

17. How many halves of 1, in two and one-half?

ANALYSIS.—*In 2 there are 4 halves; 4 halves and 1 half are 5 halves: Therefore, in $2\frac{1}{2}$, there are 5 halves.*

18. How many halves are there in $1\frac{1}{2}$? In $3\frac{1}{2}$? In $9\frac{1}{2}$?
19. How many thirds in $2\frac{1}{3}$? In $1\frac{2}{3}$? In $5\frac{2}{3}$? In $7\frac{1}{3}$?

20. How many fifths in 2 ? In $2\frac{4}{5}$? In $4\frac{3}{5}$? In $9\frac{1}{5}$?

21. How many ninths in $3\frac{2}{9}$? In $4\frac{1}{9}$? In $6\frac{5}{9}$?

22. How many fourths in $2\frac{1}{4}$? In $2\frac{3}{4}$? In $8\frac{1}{4}$?

23. How many sixths in $1\frac{1}{6}$? In $3\frac{5}{6}$? In $4\frac{2}{6}$? In $5\frac{1}{6}$?

24. How many eighths in $3\frac{5}{8}$? In $6\frac{7}{8}$? In $9\frac{2}{8}$?

25. How many twelfths in $3\frac{1}{12}$? In $5\frac{7}{12}$? In $9\frac{3}{12}$?

26. How many units 1 are there in $\frac{5}{2}$?

ANALYSIS.—*There are 2 halves in 1: in 5 halves there are as many times 1 as 2 is contained times in 5, which is 2 and one-half times: Therefore, in $\frac{5}{2}$, there are $2\frac{1}{2}$ units.*

27. How many units in 6 halves ? In 8 halves ?

28. How many units in $\frac{6}{3}$? In $\frac{15}{3}$? In $\frac{27}{3}$? In $\frac{36}{3}$?

29. How many units in $\frac{12}{4}$? In $\frac{8}{4}$? In $\frac{40}{4}$? In $\frac{60}{4}$?

30. To how many units 1 are $\frac{12}{6}$ equal ? To how many units 1 are $\frac{30}{6}$ equal ? $\frac{42}{6}$? $\frac{72}{6}$?

31. To how many units 1 are $\frac{20}{5}$ equal ? To how many units 1 are $\frac{30}{5}$ equal ? $\frac{50}{5}$? $\frac{60}{5}$? $\frac{45}{5}$?

32. How many units 1 in $\frac{28}{7}$? In $\frac{84}{7}$? In $\frac{14}{7}$?

33. How many units 1 in $\frac{18}{9}$? In $\frac{36}{9}$? In $\frac{54}{9}$?

34. In $\frac{56}{8}$, how many units ? In $\frac{65}{8}$? In $\frac{37}{8}$? In $\frac{75}{8}$?

35. In $\frac{36}{12}$, how many units ? In $\frac{60}{12}$? In $\frac{84}{12}$? In $\frac{96}{12}$?

36. How many units in $\frac{22}{11}$? In $\frac{88}{11}$? In $\frac{66}{11}$? In $\frac{99}{11}$?

37. How many units in $\frac{30}{10}$? In $\frac{100}{10}$? In $\frac{50}{10}$? In $\frac{120}{10}$?

38. How many units are there in $\frac{9}{2}$? In $\frac{15}{2}$? In $\frac{3}{2}$?

39. How many units in $\frac{7}{3}$? In $\frac{9}{4}$? In $\frac{17}{4}$? In $\frac{19}{4}$?

40. How many units in $\frac{21}{4}$? In $\frac{25}{3}$? In $\frac{25}{6}$? In $\frac{39}{5}$?

41. How many units in $\frac{43}{4}$? In $\frac{50}{4}$? In $\frac{72}{7}$? In $\frac{94}{11}$?

42. How many units in $\frac{56}{9}$? In $\frac{56}{5}$? In $\frac{56}{11}$? In $\frac{56}{12}$?

LESSON IV.

The *value* of a fraction, is the number of times which it contains the unit 1.

Note.—The teacher will easily explain, from the diagram, in connection with Lesson II., the following principles of fractions :

1. If the numerator be multiplied by any number, the value of the fraction will be increased as many times as there are units in the multiplier.

2. If the numerator be divided by any number, the value of the fraction will be diminished as many times as there are units in the divisor.

3. If the denominator be multiplied by any number, the value of the fraction will be diminished as many times as there are units in the multiplier.

4. If the denominator be divided by any number, the value of the fraction will be increased as many times as there are units in the divisor.

5. If both terms of a fraction be multiplied by the same number, the value of the fraction will not be changed

6. If both terms of a fraction be divided by the same number, the value of the fraction will not be changed.

7. In $\frac{2}{3}$ of 1, how many twelfths ?

Analysis.—*In* 2 *thirds there are twice as many twelfths as in* 1 *third ; in* 1 *third there are* 4 *twelfths : Therefore, in* 2 *thirds, there are* 2 *times* 4 *twelfths, which are* 8 *twelfths.*

8. In $\frac{5}{7}$ of 1, how many twenty-firsts ?   In $\frac{2}{3}$?

9. In $\frac{4}{7}$ of 1, how many forty-ninths ?   In $\frac{3}{7}$?

10. In $\frac{5}{12}$ of 1, how many sixtieths ?   In $\frac{1}{20}$?

11. In $\frac{4}{15}$ of 1, how many forty-fifths?　　In $\frac{3}{5}$?

12. In $\frac{5}{11}$ of 1, how many thirty-thirds?　　In $\frac{3}{11}$?

13. In $\frac{9}{10}$ of 1, how many fiftieths?　　In $\frac{2}{25}$?

14. In $\frac{11}{16}$ of 1, how many forty-eighths?　　In $\frac{3}{24}$?

15. In $\frac{3}{20}$ of 1, how many hundredths?　　In $\frac{4}{10}$?

16. In $\frac{5}{25}$ of 1, how many fiftieths?　　In $\frac{6}{10}$?

17. In $\frac{6}{9}$ of 1, how many twenty-sevenths?　In $\frac{5}{3}$?

18. In $2\frac{1}{2}$, how many times $\frac{1}{4}$?　　How many times $\frac{1}{8}$?

Note.—Reduce $2\frac{1}{2}$ to an improper fraction.

19. In $2\frac{3}{4}$, how many times $\frac{1}{16}$?　　How many 24ths?

20. In $5\frac{1}{6}$, how many times $\frac{1}{30}$?　　How many 18ths?

21. In $4\frac{1}{3}$, how many times $\frac{1}{12}$?　　How many 15ths?

Note.—The operations under the analysis are equivalent to multiplying the numerator and denominator by the same number.

22. How many ninths are there in $\frac{24}{54}$?

Analysis.—In $\frac{1}{9}$ there are 6 *fifty-fourths*: in 24 *fifty-fourths*, there are as many ninths as 6 is contained times in 24, which are 4 times: Therefore, in $\frac{24}{54}$, there are 4 ninths.

23. How many fifths are there in $\frac{18}{30}$?　　In $\frac{21}{35}$?

24. How many sevenths are there in $\frac{28}{49}$?　　In $\frac{12}{42}$?

25. How many eighths are there in $\frac{18}{48}$?　　In $\frac{63}{72}$?

26. How many thirds are there in $\frac{24}{18}$?　　In $\frac{24}{36}$?

27. How many tenths are there in $\frac{15}{30}$?　　In $\frac{9}{90}$?

28. How many halves are there in $\frac{27}{54}$?　　In $\frac{12}{6}$?

29. How many fifteenths are there in $\frac{20}{60}$?　In $\frac{35}{105}$?

30. How many eighteenths in $\frac{15}{54}$?　　In $\frac{35}{90}$?

Note.—The operations under this analysis are equivalent to dividing the numerator and denominator by the same number.

LESSON V.

1. A fraction is said to be in its *lowest terms*, when there is no number, greater than 1, that will exactly divide the numerator and the denominator.

2. Reduce $\frac{12}{16}$ to its lowest terms.

ANALYSIS.—4 *will exactly divide the numerator and the denominator, giving the fraction* $\frac{3}{4}$: *no number, greater than 1, will exactly divide* 3 *and* 4: *Therefore,* $\frac{3}{4}$ *are the lowest terms of* $\frac{12}{16}$.

3. What are the lowest terms of $\frac{8}{10}$?   Of $\frac{4}{12}$?

4. What are the lowest terms of $\frac{6}{16}$?   Of $\frac{10}{16}$?

5. What are the lowest terms of $\frac{3}{12}$?   Of $\frac{6}{12}$?

6. What are the lowest terms of $\frac{4}{8}$?   Of $\frac{2}{8}$?

7. What are the lowest terms of $\frac{2}{14}$?   Of $\frac{4}{14}$?

8. What are the lowest terms of $\frac{5}{15}$?   Of $\frac{9}{15}$?

9. What are the lowest terms of $\frac{8}{24}$?   Of $\frac{16}{24}$?

10. What are the lowest terms of $\frac{96}{150}$?   Of $\frac{100}{150}$?

11. What are the lowest terms of $\frac{36}{120}$?   Of $\frac{40}{120}$?

12. What are the lowest terms of $\frac{70}{25}$?   Of $\frac{60}{25}$?

13. What are the lowest terms of $\frac{110}{60}$?   Of $\frac{50}{60}$?

14. What are the lowest terms of $\frac{36}{72}$?   Of $\frac{30}{70}$?

15. What are the lowest terms of $\frac{120}{200}$?   Of $\frac{150}{75}$?

NOTE.—The operations under this analysis are equivalent to dividing the numerator and denominator by the same number.

☞ Reduce every fraction to its lowest terms, in every operation

16. Fractions have a *common denominator*, when they have the same fractional unit. Thus, $\frac{2}{5}$ and $\frac{3}{5}$ have a common denominator 5, the fractional unit in each being $\frac{1}{5}$

17. Reduce $\frac{2}{3}$ and $\frac{3}{5}$ to equivalent fractions having a common denominator.

ANALYSIS.—$\frac{2}{3}$ *is reduced to fifteenths by multiplying both terms by 5 (the denominator of the second fraction):* $\frac{3}{5}$ *is reduced to fifteenths by multiplying both terms by 3 (the denominator of the first fraction). Therefore,* $\frac{10}{15}$ *and* $\frac{9}{15}$ *are the equivalent fractions having a common denominator.*

NOTE.—If there are more than two fractions, multiply both terms of each by such a number as will reduce them all to the same fractional unit.

18. Reduce to a common denominator, $\frac{1}{2}$ and $\frac{4}{5}$.

19. Reduce to a common denominator, $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{3}{4}$.

20. Reduce to a common denominator, $\frac{3}{4}$ and $\frac{7}{8}$.

21. Reduce to a common denominator, $\frac{1}{5}$, $\frac{1}{2}$, and $\frac{3}{4}$.

22. Reduce to a common denominator, $\frac{7}{8}$ and $\frac{5}{7}$.

23. Reduce to a common denominator, $\frac{3}{4}$, $\frac{1}{2}$, and $\frac{3}{5}$.

24. Reduce to a common denominator, $2\frac{1}{5}$ and $\frac{1}{3}$.

25. Reduce to a common denominator, $\frac{3}{4}$ and $3\frac{1}{2}$.

26. Reduce to a common denominator, $\frac{3}{7}$ and $\frac{5}{9}$.

27. Reduce to a common denominator, $\frac{1}{2}$, $\frac{3}{5}$, and $\frac{1}{4}$.

28. Reduce to a common denominator, $\frac{3}{5}$, $\frac{4}{3}$, and $\frac{3}{2}$.

LESSON VI.

1. If an orange costs $\frac{3}{10}$ of a dime, and a lemon $\frac{2}{10}$ of a dime, what will be the cost of both?

ANALYSIS.—*The orange and the lemon will cost as many dimes as* $\frac{3}{10}$ *of a dime and* $\frac{2}{10}$ *of a dime taken together:* $\frac{3}{10} + \frac{2}{10} = \frac{5}{10} = \frac{1}{2}$: *Therefore, the orange and lemon will cost* $\frac{1}{2}$ *of a dime.*

2. A pound of butter costs $\frac{3}{16}$ of a dollar, and a pound of tea $1\frac{4}{16}$ of a dollar: what is the cost of both?

3. If an arithmetic costs $\frac{5}{8}$ of a dollar, a reader $\frac{3}{8}$ of a dollar, and a dictionary $\frac{7}{8}$ of a dollar, what will the three cost?

4. What is the sum of $\frac{2}{6}$ and $\frac{7}{6}$?

5. What is the sum of $1\frac{3}{7}$, $\frac{4}{7}$, and $\frac{1}{7}$?

6. What is the sum of $\frac{3}{8}$, $\frac{7}{8}$, and $\frac{2}{8}$?

7. What is the sum of $\frac{1}{9}$, $1\frac{0}{9}$, and $1\frac{2}{9}$?

8. What is the sum of $\frac{1}{2}$, $\frac{5}{2}$, $\frac{6}{2}$, and $\frac{7}{2}$?

9. A boy, having some money, spent $\frac{3}{12}$ of it for a ball, $\frac{2}{12}$ of it for a bat, and $\frac{6}{12}$ of it for gloves: what did he pay for all?

10. A grocer received $\frac{1}{4}$ of a dollar for butter, $\frac{3}{4}$ of a dollar for tea, and $\frac{5}{4}$ of a dollar for sugar: how many dollars did he receive for all?

11. A man paid $2\frac{1}{2}$ dollars for shoes, $9\frac{1}{2}$ dollars for a coat, and $3\frac{3}{2}$ dollars for a vest: what did the entire outfit cost?

Note.—Add the whole numbers and fractions separately, and then take the sum of the results.

12. A boy wished to buy a ball; he had $3\frac{2}{5}$ dimes, but he required $2\frac{4}{5}$ dimes more: what was the price of the ball?

13. If a ball costs $\frac{1}{4}$ of a dollar, and a bat $\frac{1}{3}$ of a dollar, what is the cost of both?

Analysis.—*The ball and bat will cost the sum of $\frac{1}{4}$ and $\frac{1}{3}$ of a dollar: To add $\frac{1}{4}$ and $\frac{1}{3}$, they must be reduced to the same fractional unit:*

$$\frac{1}{4} = \frac{3}{12}, \text{ and } \frac{1}{3} = \frac{4}{12}; \quad \frac{3}{12} + \frac{4}{12} = \frac{7}{12}:$$

Therefore, the ball and bat will cost $\frac{7}{12}$ of a dollar

14. William buys a kite for $\frac{2}{3}$ of a dollar, and a string for $\frac{4}{15}$ of a dollar: how much does he pay?

15. On Monday, James received $\frac{1}{4}$ of a dollar, and on Tuesday, $\frac{3}{5}$ of a dollar: how much did he receive on both days?

16. James weeded $\frac{1}{3}$ of the garden on Tuesday, $\frac{1}{4}$ of it on Thursday, and $\frac{1}{6}$ of it on Friday: how much of it did he weed?

17 What is the sum of $\frac{2}{7}$ and $\frac{3}{14}$?

18. What is the sum of $\frac{3}{8}$ and $\frac{6}{24}$?

19. What is the sum of $\frac{4}{9}$ and $\frac{3}{4}$?

20. What is the sum of $\frac{2}{3}$ and $\frac{5}{12}$?

21. What is the sum of $\frac{5}{8}$ and $\frac{4}{3}$?

22. What is the sum of $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{5}{6}$?

23. What is the sum of $\frac{3}{4}$, $\frac{7}{8}$, and $\frac{2}{5}$?

24. If a turkey costs $\frac{7}{8}$ of a dollar, a goose $\frac{1}{4}$ of a dollar, and 2 chickens $\frac{1}{2}$ of a dollar, how much will the whole cost?

25. A father paid $\frac{3}{4}$ of a dollar for his own breakfast, $\frac{1}{3}$ of a dollar for his son's, and $\frac{1}{5}$ of a dollar for his daughter's: how much did he pay in all?

26. James spends $6\frac{1}{4}$ cents for candy, $12\frac{1}{2}$ cents for a top, and $5\frac{1}{5}$ cents for a slate: what did they all cost?

27. If 5 yards of muslin cost $\frac{7}{8}$ of a dollar, and 9 pair of stockings $2\frac{3}{4}$ dollars, what will the whole cost?

28. A man traveled $2\frac{1}{5}$ miles the first hour, $3\frac{1}{4}$ miles the second, and $4\frac{1}{3}$ the third: how far did he travel in the three hours?

29. A person spent $\frac{4}{5}$ of a dollar for a book, $\frac{7}{8}$ of a dollar for $\frac{1}{2}$ of a ream of paper, and had $\frac{3}{4}$ of a dollar left: how much had he at first?

30. A small tradesman sold $\frac{1}{4}$ of his apples for 25 cents, $\frac{1}{3}$ of them for 30 cents, $\frac{2}{5}$ of them for 37 cents, and $\frac{1}{60}$ of them for 2 cents: what part of his apples was sold, and at what price?

31. A person had 5 half-dollar pieces, 7 quarter-dollar pieces, 3 tenth-dollar pieces, and 11 twentieth-dollar pieces: how many dollars had he in the whole?

LESSON VII.

1. James had $\frac{7}{8}$ of a dollar, and spent $\frac{3}{8}$ of a dollar for a book: how much had ne left?

ANALYSIS.—*Since ·he took $\frac{3}{8}$ of a dollar from $\frac{7}{8}$ of a dollar, he had the difference left: $\frac{3}{8}$ from $\frac{7}{8}$ leaves $\frac{4}{8}$: Therefore, he had $\frac{4}{8}$ of a dollar left.*

2. If a knife costs $\frac{15}{16}$ of a dollar, and a ball $\frac{9}{16}$ of a dollar, how much more does the knife cost than the ball?

3. William received $\frac{19}{20}$ of a dollar from his father, and Thomas $\frac{13}{20}$ of a dollar: how much more has William than Thomas?

4. John bought a sled for $\frac{9}{10}$ of a dollar; not pleased with his purchase, he sold it, and lost $\frac{3}{10}$ of a dollar: for what did he sell the sled?

5. What must be added to $\frac{3}{19}$, to make it $\frac{17}{19}$?

6. What is the difference between $\frac{14}{21}$ and $\frac{7}{21}$?

7. What is the difference between $\frac{17}{40}$ and $\frac{14}{40}$?

8. What is the difference between $\frac{19}{25}$ and $\frac{15}{25}$?

9 What is the difference between $\frac{36}{19}$ and $\frac{17}{19}$?

10. What is the difference between $\frac{41}{18}$ and $\frac{40}{18}$?

11. If you give $3\frac{1}{2}$ oranges to one boy, and $2\frac{1}{2}$ oranges to another, how much more do you give to one than to the other?

12 A person earned $3\frac{1}{4}$ dollars, and spent $1\frac{3}{4}$ dollars: how much had he left?

13. A man bought a book, whose price was $4\frac{5}{8}$ dollars, and paid 2 dollars: how much did he still owe?

14. A barrel of flour was valued at 6 dollars; from charity, the merchant sold it to a poor woman for $3\frac{3}{4}$ dollars: how much did he give her?

15. If I have $\frac{3}{4}$ of a dollar, and give $\frac{1}{2}$ of a dollar for a knife, how much would I have left?

Note.—Change to the same fractional unit.

16. William had $\frac{5}{6}$ of a dollar, and gave $\frac{4}{9}$ of a dollar to a beggar: how much had he left?

17. John travels $\frac{4}{5}$ of a mile in the same time that Charles travels $\frac{2}{3}$: which travels the farthest, and how much?

18. A merchant sells $\frac{1}{2}$ of a barrel of sugar from a barrel $\frac{5}{7}$ full: what part was there left?

19. A tailor cut $\frac{7}{8}$ of a yard of cloth from a piece containing $1\frac{3}{4}$ yards: how much was there left?

20. John pays $\frac{6}{9}$ of a shilling for a knife, and $\frac{1}{3}$ of a shilling for a top: for which does he pay the most? How much?

21. What is the difference between $\frac{2}{3}$ and $\frac{3}{10}$?

22 What is the difference between $\frac{4}{7}$ and $\frac{4}{9}$?

23 How much is $\frac{9}{11}$ greater than $\frac{3}{4}$?

24. How much is $\frac{5}{6}$ less than $\frac{7}{8}$?

25. Two numbers, taken together, are equal to $\frac{5}{12}$, one of the numbers is $\frac{3}{16}$: what is the other?

26. Before John can go into the country, he must pay

$\frac{18}{25}$ of a dollar for his fare; he has $\frac{2}{3}$ of a dollar: how much does he need?

27. A farmer buys a calf, for which he pays $\frac{7}{3}$ dollars, and a lamb, for which he pays $\frac{9}{5}$ dollars: for which does he pay the most, and how much?

28. By mistake, a person paid $\frac{16}{25}$ of a dollar, which was $\frac{3}{10}$ of a dollar too much: how much ought he to have paid?

29. A boy took the fraction $\frac{7}{8}$, instead of $\frac{8}{7}$: what was the amount of the mistake?

30. A merchant has a lamp, for which he asks $\frac{7}{8}$ of a dollar; a person, who wished to buy it, thought that $\frac{1}{5}$ of a dollar was $\frac{2}{5}$ of a dollar more than it was worth: what did the buyer think the lamp was worth?

31. A man spent $\frac{7}{8}$ of a dollar for oranges and lemons; the oranges cost $\frac{3}{5}$ of a dollar: what did the lemons cost?

32. Three boys received, among them, $5\frac{1}{2}$ dollars; the first received $2\frac{3}{4}$ dollars, and the second $1\frac{5}{12}$ dollars: what did the third receive?

33. In a school, $\frac{2}{5}$ of the scholars study grammar, $\frac{3}{7}$ study geography, and the remainder study arithmetic: how many are studying arithmetic?

34. A person owing $5\frac{1}{4}$ dollars, paid $3\frac{2}{3}$ dollars: how much did he still owe?

Note.—Subtract the fractions and the whole numbers separately, and combine the results. If the fraction of the subtrahend is the greater, take 1 from the whole number of the minuend, and add it to the fractional part. Thus, in the last example,

From $5\frac{1}{4}$ dollars, take $3\frac{2}{3}$ dollars; $\frac{1}{4} = \frac{3}{12}$, and $\frac{2}{3} = \frac{8}{12}$. We cannot take $\frac{8}{12}$ from $\frac{3}{12}$; we, therefore, take 1 from the units of the minuend, and add it to the fractional units, making $1\frac{5}{12}$; from $1\frac{5}{12}$ take $\frac{8}{12}$, and $\frac{7}{12}$ are left; now take 3 from 4: Therefore, he still owed $1\frac{7}{12}$.

35 What is the difference of $6\frac{3}{4}$ dollars and $4\frac{2}{8}$ dollars?

36 Take $7\frac{6}{11}$ from $12\frac{3}{12}$.

37. What is the difference of $6\frac{2}{3}$ and $8\frac{3}{14}$?

38. A grocer bought $16\frac{4}{9}$ bushels of beans: after selling $5\frac{2}{3}$ bushels, how many has he left?

39. Jane is $15\frac{6}{9}$ years old, and Nancy is $9\frac{6}{7}$ years old; how many years is Jane older than Nancy?

40. A draper cuts $5\frac{6}{7}$ yards of cloth from a piece $21\frac{1}{4}$ yards long: how much is left?

41. A grocer bought a pair of chickens for $\frac{8}{9}$ of a dollar, and sold them for $\frac{9}{8}$ dollars: did he make or lose, and how much?

42. A grocer purchased a box of eggs, for which he paid $3\frac{1}{5}$ dollars, and sold them for $5\frac{3}{4}$ dollars: how much did he make?

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LESSON VIII.

1. If 1 pound of tea costs $\frac{3}{5}$ of a dollar, how much will 4 pounds cost?

ANALYSIS.—*Four pounds will cost* 4 *times as much as* 1 *pound:* 4 *times* $\frac{3}{5}$ *of a dollar are* $\frac{12}{5}$ *dollars, equal* $2\frac{2}{5}$ *dollars: Therefore,* 4 *pounds will cost* $2\frac{2}{5}$ *dollars.*

2. If $\frac{6}{8}$ of a dollar will pay a woman for one day's work, how much will pay for 7 days?

3. At $\frac{6}{7}$ of a dollar a bushel, what is the cost of 5 bushels of potatoes?

4. What is the cost of 5 pounds of paint, at $\frac{2}{8}$ of a dime per pound?

5. How many times 1 are 4 times $\frac{6}{7}$?

6. How many times 1 are 9 times $\frac{2}{8}$?

7. How many dollars would a boy receive for 9 days' labor, at $\frac{4}{5}$ of a dollar a day?

8. If $\frac{5}{8}$ of a peck of oats are required to feed a horse one day, how much would be required for 9 horses?

9. If the current of a river runs $\frac{9}{10}$ of a mile an hour, how far would it carry a boat in 8 hours?

10. What will 5 barrels of flour cost, at $6\frac{3}{4}$ dollars a barrel?

ANALYSIS.—*Five barrels will cost 5 times as much as one barrel:* 5 *times* $\frac{3}{4}$ *of a dollar are* $\frac{15}{4}$ *dollars, equal to* $3\frac{3}{4}$ *dollars;* 5 *times* 6 *dollars are* 30 *dollars: Therefore,* 5 *barrels will cost* $33\frac{3}{4}$ *dollars.*

11. What will nine hats cost, at $3\frac{2}{3}$ dollars apiece?

12. If a pair of shoes is worth $2\frac{1}{2}$ dollars, what will 5 pair be worth? 7 pair? 10 pair?

13. If board costs $4\frac{1}{4}$ dollars a week, what will be the cost of 3 weeks' board? 6 weeks'? 10 weeks'?

14. How much are 6 times $3\frac{1}{3}$? $2\frac{5}{6}$? $5\frac{1}{4}$?

15. How much must be paid for traveling 9 miles, at $2\frac{3}{5}$ cents a mile? At $3\frac{4}{7}$ cents? At $5\frac{1}{6}$ cents?

16. If a person walks $3\frac{7}{8}$ miles an hour, how far would he walk in 4 hours? In 7 hours?

17. If a barrel of flour is worth $5\frac{4}{9}$ dollars, what will be the worth of 10 barrels? 12 barrels?

18. If a mahogany chair costs $3\frac{3}{5}$ dollars, what will one dozen chairs cost? What will $\frac{1}{2}$ of a dozen cost?

19. $4\frac{1}{2}$ is one-half of what number?

20. $5\frac{1}{3}$ is one-fifth of what number?

21. $9\frac{1}{3}$ is one-sixth of what number?

22. Two and 3 fourths, is one-fourth of what number?

23. One and 4 fifths, is one-half of what number?

24. Two and 3 fifths, is one-fifth of what number?

25. Four and 2 sixths, is one-seventh of what number?
26. Two and 5 sixths, is one-sixth of what number?
27. One and 3 sevenths, is one-eighth of what number?
28. Two and 4 ninths, is one-ninth of what number?
29. Three and 6 tenths, is one-tenth of what number?
30. One and 7 elevenths, is 1 eleventh of what number?
31 Two and 9 twelfths, is one-twelfth of what number?

LESSON IX.

1. If one-fourth of a pineapple costs 2 cents, what will the pineapple cost?

ANALYSIS.—*Since 4 fourths make 1, the pineapple must cost 4 times as much as one-fourth of it: 4 times 2 cents are 8 cents: Therefore the pineapple will cost 8 cents.*

2. If one-half of an orange costs 2 cents, what will the orange cost?

3. If one-third of a bushel of wheat is worth 3 shillings, how much are 2 thirds worth? One bushel?

4. If one-third of a barrel of flour costs 2 dollars, what will 5 barrels cost?

5. If one-fourth of a yard of cloth costs 1 dollar, what will 2 fourths cost? $\frac{3}{4}$? 3 yards?

6. If a laborer, in $\frac{1}{9}$ of a month, earns 4 dollars, how much will he earn in one month? In 5 months?

7. If 5 dollars will pay for $\frac{1}{9}$ of a month's wages, how much will pay for the month's wages?

8. If 3 is one-seventh of a number, what is 2 sevenths of the number? 6 sevenths? What is the number?

9. 12 is half of what number? One-third of what?

10.   8 is one-fourth of what number?   One-fifth of what?   One-seventh of what?

11.   A grocer gains, on a pound of butter, 5 cents, which is one-fifth of the cost: what is the cost?

12.   If 16 is one-eighth of a number, how much are $\frac{3}{8}$? How much are $\frac{5}{8}$? $\frac{7}{8}$?   What is the number?

13.   If one-twelfth of a box of raisins costs 30 cents, what will be the cost of 2 boxes?

14.   If 5 pounds are one-sixth of the weight of a ream of paper, what is the weight of the entire ream?

15.   A clerk, in passing to the bank, lost 10 dollars, which was one-twelfth of all the money he carried : how much had he when he left the store?

16.   If one-fourth of a pound of butter costs 7 cents, what is the cost of one pound?   Of 6 pounds?

17.   A pole is standing in the water, and has 5 feet of its length out of water, which is one-seventh of its length : how long is the pole?

18.   If 8 horses consume a quantity of oats in one month, how many would consume it in $\frac{1}{4}$ of a month?

19.   If 6 men can dig a ditch in a week, how many men would be required to do it in $\frac{1}{6}$ of a week?

20.   If 100 soldiers can rebuild a burnt bridge in one week, how many could do it in $\frac{1}{7}$ of a week?

21.   If a barrel of flour will last a family of 10 persons one month, how many persons would it support during $\frac{1}{4}$ of a month?

22.   If one-sixth of a day is 4 hours, how many hours are there in $2\frac{5}{6}$ days?

ANALYSIS.—$2\frac{5}{6}$ *days are equal to* $\frac{17}{6}$ *days, which are 17 times* $\frac{1}{6}$: *in* $\frac{1}{6}$ *of a day there are 4 hours : There-fore, in* $2\frac{5}{6}$ *days, there are 17 times 4 hours, which are 68 hours*

23. What is the cost of riding $9\frac{1}{2}$ miles, at 3 cents a half mile?

24. If $\frac{1}{3}$ of a barrel of flour is worth 2 dollars, what is the value of $4\frac{1}{3}$ barrels? Of $7\frac{2}{3}$ barrels?

25. If 3 oranges can be bought for $\frac{1}{15}$ of a dollar, how many can be bought for $\frac{4}{15}$ of a dollar?

26. If, in $\frac{1}{6}$ of a day, a man earn 2 dollars, how much will he earn in $1\frac{2}{6}$ days?

27. How much must be paid for $4\frac{3}{8}$ yards of cloth, if $\frac{1}{8}$ of a yard costs 1 dollar?

28. If a mason can lay 5 feet of wall in $\frac{1}{5}$ of a month, how many feet can he lay in $2\frac{2}{5}$ months?

29. If 1 twelfth of a piece of cloth costs 3 dollars, what will be the cost of half the piece?

30. If 4 sixths of a yard of ribbon cost 8 cents, how much will one-sixth of a yard cost?

ANALYSIS.—*One-sixth of a yard will cost one-fourth as much as four-sixths: $\frac{4}{6}$ of a yard costs 8 cents: Therefore, one-sixth of a yard will cost one-fourth of 8 cents, which is two cents.*

31. If 5 sevenths of a barrel of sugar cost 15 dollars, what will one-seventh cost? 1 barrel?

32. If 4 ninths of a barrel of shad cost 4 dollars, what will 8 ninths of a barrel cost?

33. If $\frac{3}{4}$ of a pound of coffee cost 12 cents, how much will $\frac{1}{4}$ of a pound cost? 1 pound?

34. If $\frac{4}{5}$ of a pound of tea cost 40 cents, what will 1 pound cost? 3 pounds?

35. How far will a steamer go in 1 hour, if it goes 14 miles in $\frac{7}{9}$ of an hour?

36. If 9 fourths of a yard of muslin cost 18 cents, what will 2 yards cost? 12 yards?

37. If $1\frac{3}{4}$ yards of cloth cost 14 dollars, what will 9 yards cost?

38. If $\frac{2}{5}$ of a barrel of flour will last a family 4 weeks, how long will 2 barrels last?

39. If $2\frac{1}{2}$ weeks' board cost 15 dollars, what will 7 weeks' board cost?

40. If the freight of $4\frac{2}{3}$ hundredweight, for 25 miles, is 42 cents, what will be the freight of $12\frac{1}{4}$ hundredweight?

41. If $3\frac{1}{5}$ tons of hay will feed 16 horses 5 days, how many horses would $6\frac{4}{5}$ tons feed during the same time?

42. If $2\frac{4}{7}$ reams of paper weigh 36 pounds, how much will 5 reams weigh? $6\frac{2}{7}$ reams?

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LESSON X.

1. What is $\frac{1}{3}$ of 5?

ANALYSIS.— $\frac{1}{3}$ of 5 is 5 times as much as $\frac{1}{3}$ of 1. $\frac{1}{3}$ of 1 is $\frac{1}{3}$: Therefore, $\frac{1}{3}$ of 5, is 5 times $\frac{1}{3}$, which is $\frac{5}{3}$, equal to $1\frac{2}{3}$.

2. What is $\frac{1}{4}$ of 6? Of 9? Of 15? Of 27?

3. What is $\frac{1}{5}$ of 9? Of 17? Of 19? Of 31?

4. What is the value of $\frac{1}{6}$ of 5? Of 19? Of 17?

5. What is the value of $\frac{1}{7}$ of 2? Of 9? Of 11?

6. If 8 barrels of flour are valued at 43 dollars, what is the value of one barrel?

7. How much is $\frac{1}{9}$ of 2? Of 101? Of 15?

8. What is $\frac{1}{12}$ of 63? Of 3? Of 67? Of 91?

9. What is $\frac{1}{15}$ of 14? Of 7? Of 21? Of 71?

10. If a person rides 6 miles for 5 cents, how much is that per mile?

11. The weekly wages of a mechanic are 15 dollars: what is that per day, allowing 6 days to the week?

12. A ditch, 50 feet in length, is to be dug. A is to dig $\frac{1}{9}$ of it, B $\frac{1}{7}$, C $\frac{1}{5}$, and D the remainder: how many feet do A, B, and C each dig?

13. If a person is to receive 29 dollars for 7 days' labor, how much ought he to receive for 3 days'?

ANALYSIS.—*For* 1 *day's labor he will receive* $\frac{1}{7}$ *of* 29 *dollars, which is* $4\frac{1}{7}$ *dollars: for three days' labor, he will receive three times as much: Therefore, he will receive* 3 *times* $4\frac{1}{7}$ *dollars, which is* $12\frac{3}{7}$ *dollars.*

14. How much must be paid for 9 pounds of sugar, at the rate of 72 cents for 14 pounds?

15. If each of 10 men draws equally strong, and together they lift 25 hundredweight, how much do 3 of them lift?

16. If 100 dollars will pay for the board of one person 25 weeks, how long would it keep 12 persons? What is the price of board per week?

17. In a factory, 6 boys and 5 men are employed; the weekly wages of them all amount to 88 dollars, and the wages of one man is equal to that of 2 boys: how much does each man and each boy receive?

18. If 29 yards of cloth will make 12 pair of pantaloons, how many yards will be required for 7 pair?

19. If a length of 20 feet is divided exactly into equal intervals, by 10 pins, how long is each interval?

ANALYSIS.—*Since there are* 10 *points of division, there must be nine equal intervals: each interval is* $\frac{1}{9}$ *of* 20 *feet: Therefore, each interval is* $2\frac{2}{9}$ *feet in length.*

20. From a cannon, 12 balls are fired in 30 minutes, at equal intervals: how many minutes between the balls?

21. A carpenter wishes to put ornaments on the cornice of a house, that is 25 feet in front. If he employs 6 ornaments, at what intervals must he place their centers, supposing the centers of the first and last to be $\frac{1}{2}$ of a foot from the corner?

22. On a foot-rule, there are, in the space of 3 inches, 13 lines of division, including the end lines: what is the value of the intervals between the lines?

23. In a store, stools are required for the accommodation of customers; the distance between the first and last stool is 50 feet, and there are to be altogether 16 stools: how far apart are the centers of the stools?

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LESSON XI.

1. What are $\frac{2}{3}$ of 5 dollars?

ANALYSIS.—*Two-thirds of 5 dollars are 2 times $\frac{1}{3}$ of 5 dollars: $\frac{1}{3}$ of 5 dollars is $\frac{5}{3}$ of 1 dollar: There-fore, $\frac{2}{3}$ of 5 dollars are $\frac{10}{3}$ dollars, equal $3\frac{1}{3}$ dollars*

2. What are $\frac{3}{4}$ of 15 dollars? Of 17 dollars?

3. If 1 day's labor is worth 2 dollars, what is the value of $\frac{5}{6}$ of a day's labor? Of $\frac{5}{9}$ of a day's labor?

4. What are $\frac{7}{8}$ of 2? Of 5? Of 12? Of 15?

5. What are $1\frac{1}{12}$ of 18? Of 12? Of 5? Of 8?

6. What are $\frac{9}{10}$ of 3? Of 7? Of 9? Of 71?

7. What are $\frac{6}{7}$ of 21? Of 9? Of 7? Of 60?

8. What are $\frac{3}{8}$ of 7? Of 36? Of 51? Of 73?

9. What are $\frac{2}{9}$ of 2? Of 10? Of 50? Of 37?

10. How many are $\frac{4}{5}$ of 17? Of 27? Of 31?

11. How many are $\frac{9}{11}$ of 6? Of 26? Of 31?

12. How many are $1\frac{2}{3}$ of 5? Of 8? Of 30?

13. What will $\frac{3}{4}$ of a pound of butter cost, at 20 cents a pound?

14. I wish to buy a ton of Liverpool coal, worth 13 dollars a ton; the coal merchant has only $\frac{7}{8}$ of a ton: how much must I pay him for that?

15. John and Samuel hire a carriage for 5 dollars: John agreed to pay $\frac{5}{8}$ of the hire, and Samuel the remainder: how much did each pay?

16. Robert is $\frac{5}{6}$ as old as Mary, who is 17 years of age: how old is Robert?

17. If 7 hats cost 24 dollars, what will be the cost of 5 hats, at the same rate?

ANALYSIS.—*One hat will cost $\frac{1}{7}$ as much as 7 hats, and 5 hats will cost 5 times as much as 1 hat: $\frac{1}{7}$ of 24 dollars is $3\frac{3}{7}$ dollars, and 5 times that are $17\frac{1}{7}$ dollars: Therefore, 5 hats will cost $17\frac{1}{7}$ dollars.*

18. If an army moves 28 miles in 5 days, how far will it move in 6 days?

19. If 9 yards of cloth cost 13 dollars, what will be the cost of 5 yards, at the same rate?

20. If 12 men can do a piece of work in 3 days, how much of it can 3 men do in the same time?

21. If 5 dollars will pay for 48 pounds of raisins, how many pounds can be bought for 9 dollars?

22. If 3 pounds of sugar cost 32 cents, what will 2 pounds cost?

23 How much will 3 days' work amount to, if 5 days' amount to 12 dollars?

24. If $\frac{2}{3}$ of a yard of broadcloth is worth 5 dollars, how much are 3 yards worth?

25. If 3 barrels of cider are worth 8 dollars, what will be the value of 5 barrels?

26. William and James hire a boat for 2 hours, at 5 shillings an hour; James is to pay 3 tenths, and William the rest: how much does each pay?

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LESSON XII.

1. What is $\frac{1}{2}$ of $\frac{1}{2}$?

ANALYSIS.—*There are two halves in 1: if each half be divided into two equal parts, either of these parts will be $\frac{1}{2}$ of $\frac{1}{2}$, and there will be 4 of them in 1: There-fore, $\frac{1}{2}$ of $\frac{1}{2}$, is $\frac{1}{4}$ of 1.*

2. What is $\frac{1}{2}$ of $\frac{1}{3}$? $\frac{1}{2}$ of $\frac{1}{4}$? $\frac{1}{2}$ of $\frac{1}{5}$? $\frac{1}{2}$ of $\frac{1}{6}$?

3. What is $\frac{1}{3}$ of $\frac{1}{2}$? $\frac{1}{3}$ of $\frac{1}{3}$? $\frac{1}{3}$ of $\frac{1}{4}$? $\frac{1}{3}$ of $\frac{1}{5}$?

4. What is $\frac{1}{4}$ of $\frac{1}{2}$? $\frac{1}{4}$ of $\frac{1}{3}$? $\frac{1}{4}$ of $\frac{1}{8}$? $\frac{1}{4}$ of $\frac{1}{10}$?

5. How much is $\frac{1}{6}$ of $\frac{1}{2}$? $\frac{1}{6}$ of $\frac{1}{7}$? $\frac{1}{6}$ of $\frac{1}{12}$?

6. How much is $\frac{1}{9}$ of $\frac{1}{3}$? $\frac{1}{9}$ of $\frac{1}{5}$? $\frac{1}{9}$ of $\frac{1}{2}$?

7. What is $\frac{1}{12}$ of $\frac{1}{2}$? $\frac{1}{12}$ of $\frac{1}{4}$? $\frac{1}{12}$ of $\frac{1}{9}$? $\frac{1}{12}$ of $\frac{1}{8}$?

8. If a pound of tea is sold for $\frac{1}{2}$ of a dollar, how much must be paid for $\frac{1}{2}$ of a pound?

9. John had $\frac{1}{4}$ of a dollar, and paid $\frac{1}{2}$ of it for a ball: what did the ball cost?

10. A bat costs $\frac{1}{3}$ as much as a ball, which is worth $\frac{1}{3}$ of a dollar: what part of a dollar does the bat cost?

11. John is $\frac{1}{5}$ as old as his father, and Mary is $\frac{1}{4}$ as old as John: Mary's age is what part of her father's age?

12. John had $\frac{1}{10}$ of a dollar, and gave $\frac{1}{5}$ of it for an orange: what part of a dollar did the orange cost?

13. A dime is $\frac{1}{10}$ of a dollar, and a cent is $\frac{1}{10}$ of a dime: what fraction of a dollar is a cent?   3 cents?

14. If $\frac{1}{5}$ of a dollar be given to 5 children, to be

equally divided among them, what part of a dollar will each receive?

15. If $\frac{1}{6}$ of a school-day is devoted to arithmetic, and $\frac{1}{4}$ as much to spelling, what fraction of the day is given to spelling?

16. After paying all debts against an estate, $\frac{1}{3}$ of it is left unincumbered, to be equally divided among 7 heirs: what part of the estate does each heir receive?

17. What is $\frac{1}{3}$ of $\frac{2}{5}$ of a dollar?

ANALYSIS.—$\frac{1}{3}$ *of* $\frac{2}{5}$ *is twice as much as* $\frac{1}{3}$ *of* $\frac{1}{5}$: $\frac{1}{3}$ *of* $\frac{1}{5}$ *is* $\frac{1}{15}$: *Therefore,* $\frac{1}{3}$ *of* $\frac{2}{5}$ *is* $\frac{2}{15}$.

18. A boy, having $\frac{3}{4}$ of a dollar, gave away $\frac{1}{2}$ of it to a beggar: how much did he give away?

19. If a pound of tea is worth $\frac{4}{5}$ of a dollar, what is $\frac{1}{4}$ of a pound worth?

20. What is $\frac{1}{2}$ of $\frac{2}{5}$? Of $\frac{3}{4}$? Of $\frac{7}{8}$? Of $\frac{9}{16}$?

21. What is $\frac{1}{5}$ of $\frac{3}{9}$? Of $\frac{7}{10}$? Of $\frac{9}{11}$? Of $\frac{4}{7}$?

22. What is $\frac{1}{7}$ of $\frac{2}{7}$? Of $\frac{5}{9}$? Of $\frac{8}{12}$? Of $\frac{9}{15}$?

23. To what is $\frac{1}{9}$ of $\frac{3}{4}$ equal? Of $\frac{5}{6}$? Of $\frac{8}{9}$?

24. To what is $\frac{1}{8}$ of $3\frac{1}{2}$ equal?

NOTE.—Change $3\frac{1}{2}$ to halves.

25. How much is $\frac{1}{6}$ of $\frac{7}{9}$? Of $2\frac{1}{4}$? Of $\frac{9}{6}$?

26. What is $\frac{1}{10}$ of $4\frac{1}{3}$? Of $\frac{8}{17}$? Of $5\frac{1}{2}$? Of $\frac{7}{15}$?

27. What is $\frac{1}{3}$ of $\frac{6}{7}$?

ANALYSIS.—*In* $\frac{6}{7}$, *there are six fractional units* $\frac{1}{7}$: *one-third of 6 is 2: Therefore,* $\frac{1}{3}$ *of* $\frac{6}{7}$ *is* $\frac{2}{7}$ *of 1.*

NOTE.—When we can take an exact part of the numerator, it may be done; when we can not, we must analyze by the analysis of question 17 of this lesson.

28. What is $\frac{1}{4}$ of $\frac{4}{5}$? Of $\frac{8}{9}$? Of $\frac{16}{17}$? Of $\frac{24}{25}$?

29. What is $\frac{1}{5}$ of $\frac{5}{5}$? Of $\frac{10}{12}$? Of $2\frac{2}{5}$? Of $4\frac{2}{7}$?

30. What is $\frac{1}{9}$ of $\frac{18}{21}$? Of $\frac{36}{37}$? Of $3\frac{3}{5}$? Of $6\frac{3}{4}$?

31. A gentleman divided $\frac{4}{7}$ of a barrel of flour equally among 3 poor families: what did each family receive?

32. If 6 pineapples cost $\frac{7}{8}$ of a dollar, how much will one pineapple cost?

33. A quart is $\frac{1}{4}$ of a gallon, and a gill is $\frac{1}{8}$ of a quart: what part of a gallon is one gill?

34. If a gallon of wine is sold for $3\frac{3}{4}$ dollars, what will one quart cost?

35. If 1 man can do a piece of work in $5\frac{1}{8}$ days, in what time can 7 men do it?

36. From a piece of cloth, measuring $9\frac{1}{6}$ yards, $\frac{1}{5}$ of it was cut off: how many yards were cut off?

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LESSON XIII.

1. What is $\frac{2}{3}$ of $\frac{1}{4}$?

ANALYSIS.—*Two-thirds of $\frac{1}{4}$ is twice as much as $\frac{1}{3}$ of $\frac{1}{4}$: $\frac{1}{3}$ of $\frac{1}{4}$ is $\frac{1}{12}$: Therefore, $\frac{2}{3}$ of $\frac{1}{4}$ are $\frac{2}{12}$.*

2. What is $\frac{3}{5}$ of $\frac{1}{5}$? Of $\frac{1}{6}$? Of $\frac{1}{12}$? Of $\frac{1}{7}$?

3. How much is $\frac{4}{9}$ of $\frac{1}{9}$? $\frac{3}{7}$ of $\frac{1}{8}$? $\frac{5}{12}$ of $\frac{1}{4}$?

4. How much is $\frac{7}{8}$ of $\frac{1}{8}$? $\frac{5}{6}$ of $\frac{1}{10}$? $\frac{4}{11}$ of $\frac{1}{9}$?

5. What is $\frac{8}{15}$ of $\frac{1}{2}$? $\frac{11}{12}$ of $\frac{1}{4}$? $\frac{6}{5}$ of $\frac{1}{20}$? $\frac{8}{3}$ of $\frac{1}{30}$?

6. If one pound of butter costs $\frac{1}{4}$ of a dollar, what will $\frac{5}{7}$ of a pound cost?

7. A steamship was owned by 7 merchants, in equal shares; one of the merchants was obliged to sell $\frac{3}{5}$ of his share: how much of the ship did he sell?

8. Twelve men contract to build a railroad, in equal

parts; one of the contractors employed a sub-contractor to do $\frac{4}{9}$ of his share: what part of the road was built by the sub-contractor?

9. If 1 of 10 equal shares, in a factory, is valued at a certain sum, what part of the factory will $\frac{7}{8}$ of this sum buy?

10. What is $\frac{2}{3}$ of $\frac{4}{5}$?

ANALYSIS.—*Two-thirds of $\frac{4}{5}$ is twice $\frac{1}{3}$ of $\frac{4}{5}$: $\frac{1}{3}$ of $\frac{4}{5}$ is $\frac{4}{15}$: Therefore, $\frac{2}{3}$ of $\frac{4}{5}$ are $\frac{8}{15}$.*

11. What is $\frac{3}{4}$ of $\frac{5}{6}$? $\frac{2}{7}$ of $\frac{3}{4}$? $\frac{7}{9}$ of $\frac{2}{5}$? $\frac{4}{11}$ of $\frac{6}{7}$?

12. What is $\frac{7}{8}$ of $\frac{7}{8}$? $\frac{2}{5}$ of $\frac{9}{10}$? $\frac{3}{12}$ of $2\frac{1}{2}$?

13. What is $\frac{3}{10}$ of $4\frac{1}{5}$? $\frac{2}{15}$ of $1\frac{8}{9}$? $\frac{3}{4}$ of $1\frac{5}{20}$?

14 What is $\frac{5}{12}$ of 3? $\frac{7}{9}$ of $2\frac{4}{5}$? $\frac{8}{20}$ of $\frac{5}{2}$?

15. What is $2\frac{1}{2}$ of $2\frac{1}{2}$? $\frac{3}{16}$ of $12\frac{1}{2}$? $\frac{2}{15}$ of $\frac{3}{7}$?

16 What is $\frac{5}{7}$ of $\frac{9}{10}$? $\frac{4}{9}$ of $\frac{5}{9}$? $\frac{1}{2}$ of $\frac{2}{5}$ of 3?

17. What is $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{6}$? $\frac{9}{11}$ of $\frac{4}{7}$ of $\frac{1}{2}$?

18. What is the product of $3\frac{1}{3}$ multiplied by $\frac{2}{5}$?

19. What is the product of $2\frac{3}{4}$ multiplied by $1\frac{3}{5}$?

20. What is the product of $3\frac{1}{2}$ multiplied by 2?

21. What is the product of $5\frac{1}{2}$ multiplied by 6?

22. What is the product of $\frac{1}{2}$ of $\frac{1}{3}$ by $\frac{6}{7}$?

23. What is the product of $\frac{2}{3}$ of $\frac{3}{7}$ by $\frac{7}{2}$?

24. What is the product of $\frac{2}{5}$ of $2\frac{1}{2}$ by 3?

25. If one bushel of potatoes costs $\frac{7}{8}$ of a dollar, what will $\frac{3}{4}$ of a bushel cost?

26. If a horse requires $1\frac{1}{2}$ bushels of oats a week, how much does he require in $\frac{6}{7}$ of a week?

27. A young lad receives $2\frac{1}{4}$ dollars, weekly salary: how much does he receive for $\frac{5}{6}$ of a week?

28. A merchant, finding he had only $1\frac{1}{3}$ yards of silk

left, which cost him $\frac{15}{16}$ of a dollar, sold it for $\frac{3}{4}$ of its cost : for what did he sell it ?

29. How much is $\frac{5}{9}$ of $\frac{7}{8}$ of a yard ? $\frac{4}{15}$ of $3\frac{1}{2}$ yards ?

30. A laborer, receiving $1\frac{3}{8}$ dollars a day, pays $\frac{1}{2}$ of it for groceries, and $\frac{1}{10}$ of it for rent : what part of a dollar has he left ?

31. A person bought a barrel of flour for $6\frac{1}{4}$ dollars ; having used $\frac{1}{7}$ of it, he returned the remainder, finding it damaged : what should he pay for the part he used ?

32. In a school, $\frac{7}{8}$ of the pupils are studying arithmetic ; of these, $\frac{3}{4}$ are studying book-keeping, and $\frac{2}{3}$ of those studying book-keeping are studying surveying : what portion of the school are studying surveying ?

33. A painter had $\frac{5}{6}$ of a keg of white lead, worth $2\frac{3}{4}$ dollars per keg, and used $\frac{4}{5}$ of what he had : what part of the keg did he use, and what was its value ?

34. A general took $\frac{4}{5}$ of his entire force into battle ; having won the battle, he found that $\frac{1}{25}$ of his attacking force was killed, that $\frac{1}{10}$ was wounded, and that $\frac{1}{5}$ was missing : what part of his attacking force did he lose ?

NOTE.—The last analysis explains the method of multiplying one fraction by another. The operation consists in multiplying the numerators together and the denominators together.

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LESSON XIV.

1. What will $5\frac{1}{3}$ barrels of flour cost, at 6 dollars a barrel ?

ANALYSIS.—$5\frac{1}{3}$ *barrels will cost* $5\frac{1}{3}$ *times as much as* 1 *barrel* : $5\frac{1}{3}$ *times* 6 *dollars are* 32 *dollars : Therefore,* $5\frac{1}{3}$ *barrels will cost* 32 *dollars.*

2. What will $2\frac{3}{5}$ pounds of sugar cost, at 10 cents a pound? At 15 cents a pound?

3. In a dollar there are 10 dimes: how many dimes are there in $8\frac{4}{5}$ dollars?

4. If a bag of wheat flour weighs 25 pounds, what is the weight of $6\frac{3}{8}$ bags?

5. If 40 oranges can be bought for one dollar, how many oranges can be bought for $2\frac{7}{10}$ dollars?

6. If a steamer sails 18 miles in an hour, how far would it sail in $4\frac{5}{6}$ hours? In $5\frac{7}{8}$ hours?

7. What will be the cost of $9\frac{5}{6}$ yards of silk, at 2 dollars a yard?

8. If 12 men can do a piece of work in $5\frac{3}{4}$ days, how many men could do it in one day?

9. In a day there are 24 hours: how many hours are there in $3\frac{11}{12}$ days?

10. At 9 cents a yard, what will a piece of calico, that contains $35\frac{3}{4}$ yards, cost?

11. If one bushel of oats will supply 12 horses for one day, how many horses would $7\frac{7}{12}$ bushels supply?

12. At 6 dollars a week, to what will $9\frac{5}{7}$ weeks' board amount?

13. At 4 cents a mile, what is the cost of traveling $25\frac{3}{4}$ miles?

14. If one gallon of wine will fill 8 bottles, how many bottles will be filled by $7\frac{3}{4}$ gallons?

15. The hour-hand of a clock moves over 5 spaces of the hour-circle in one hour: how far will it move in $7\frac{4}{13}$ hours?

16. If 5 dozen eggs cost 100 cents, what will be the cost of $9\frac{5}{6}$ dozen?

17. How many are 4 times 9, and $\frac{8}{11}$ of 9?

18. How many are 7 times 12, and $\frac{3}{4}$ of 12?

19. How many are 9 times 10, and $\frac{3}{20}$ of 10?

20. If a wheel, in turning once, moves over 16 feet, how far would it move in turning $8\frac{5}{12}$ times?

21. If a yard of cloth costs $2\frac{3}{5}$ dollars, what will be the cost of $3\frac{1}{2}$ yards?

ANALYSIS.—*$3\frac{1}{2}$ yards will cost $3\frac{1}{2}$ times as much as 1 yard: $2\frac{3}{5}$ dollars, taken $3\frac{1}{2}$ times, are $\frac{91}{10}$ dollars, equal $9\frac{1}{10}$ dollars: Therefore, $3\frac{1}{2}$ yards will cost $9\frac{1}{10}$ dollars.*

22. At $2\frac{1}{2}$ dollars a day, what are the wages for $3\frac{1}{8}$ days?

23. If a platform requires $10\frac{1}{3}$ yards of carpeting to cover it, what would be the cost, at $\frac{7}{8}$ of a dollar a yard?

24. What would be the cost of painting the front of a house of $73\frac{1}{3}$ square yards, at $\frac{3}{8}$ of a dollar a yard?

25. If one piece of velvet contains $10\frac{2}{3}$ yards, how many yards are contained in $4\frac{1}{2}$ pieces?

LESSON XV.

1. How many times are 2 dollars contained in 1 dollar?

2. How many times are 3 dollars contained in 1 dollar?

ANALYSIS.—*Three dollars are contained in 3 dollars 1 time: 3 dollars are contained in 1 dollar one-third as many times as in 3 dollars: Therefore, 3 dollars are contained in 1 dollar, $\frac{1}{3}$ times.*

3. How many times are 5 apples contained in 1 apple?

4. How many times are 6 cents contained in 1 cent?

5. How many times 9 in 1? How many, 16 in 1?

6. How many times 12 in 1? How many, 50 in 1?

7. If a yard of tape costs 2 cents, how many yards can be bought for 1 cent?

8. At 8 dollars a week, how long ought a laborer to work for 1 dollar?

9. If melons are selling at 18 cents each, how much can be bought for 1 cent?

10. At 3 cents each, how many oranges can be bought for 2 cents?

ANALYSIS.—*At 3 cents apiece, as many oranges can be bought for 2 cents, as 3 cents are contained times in 2 cents: 3 cents are contained in two cents two-thirds times: therefore, at 3 cents apiece, two-thirds of an orange can be bought for 2 cents.*

11. How many cakes, at 4 cents apiece, can be bought for 3 cents? For 7 cents? For 13 cents?

12. If a day's labor is worth 7 shillings, in how many days would 10 shillings be earned? 15 shillings?

13. In 3 oranges, how many dozen oranges? In 14?

14. If a yard of calico is sold for 17 cents, how many yards can be bought for 27 cents?

15. How many times is 9 contained in 5? In 8? In 12? In 28? In 41? In 54? In 120?

16. How many barrels of flour, at 6 dollars a barrel, must be given for 25 days' labor, at 3 dollars a day?

17. Forty-two are how many times 8? 9? 10?

18. Fifty-six are how many times 12? 10? 9?

19. Twenty-two are how many times 5 ?   6 ?   7 ?

20. Forty-eight are how many times 7 ?   6 ?   5 ?

21. Fifty-five are how many times 8 ?   9 ?   7 ?

22. Forty-seven are how many times 5 ?   6 ?   9 ?

23. A poor man owes 125 dollars ; his earnings are, on an average, 25 dollars per month, and his expenses 16 dollars a month : in what time will he save enough to pay off the debt ?

24. John and Thomas, who are 65 miles apart, are traveling toward each other ; John goes 6 miles an hour, and Thomas 9 miles an hour : in what time will they meet ?

25. A fox is 45 rods ahead of a greyhound, when the latter starts after him ; the hound runs 40 rods per minute, and the fox 33 rods per minute : in what time will the hound overtake the fox ?

LESSON XVI.

1. At $\frac{5}{6}$ of a dollar a pound, how many pounds of tea can be bought for $3\frac{1}{3}$ dollars ?

Note.—Reduce to the same fractional unit.

Analysis.—*As many pounds of tea can be bought for $3\frac{1}{3}$ dollars as $\frac{5}{6}$ are contained times in $3\frac{1}{3}$ dollars : $\frac{5}{6}$ are contained in $3\frac{1}{3}$, 4 times : Therefore, 4 pounds of tea can be bought for $3\frac{1}{3}$ dollars.*

2. If a boy earns $\frac{3}{20}$ of a dollar in a day, how long would it take him to earn $\frac{19}{20}$ of a dollar ?

3. How many yards of cloth, at $2\frac{1}{2}$ dollars a yard, can be bought for $37\frac{1}{2}$ dollars ?

4. If a suit of clothes requires $7\frac{1}{3}$ yards, how many suits can be made out of $29\frac{1}{3}$ yards of cloth ?

5. In how many days can a man mow a field of $8\frac{3}{4}$ acres, if he mows $1\frac{3}{4}$ acres a day?

6. If a man consumes $1\frac{1}{5}$ pounds of meat in a day, how many men would $8\frac{2}{5}$ pounds supply?

7. A boat has been carried, by the current of a river, $15\frac{3}{5}$ miles; the current runs at the rate of $2\frac{1}{7}$ miles an hour: how many hours was the boat in floating that distance?

8. A carpenter worked 6 days, at $1\frac{4}{5}$ dollars a day: how many yards of silk, at $1\frac{2}{5}$ dollars a yard, would pay him?

9. How many gallons of oil, at $\frac{8}{10}$ of a dollar a gallon, will pay for 3 vests, at $2\frac{7}{10}$ dollars each?

10. A man and boy were employed the same number of days; the man received $1\frac{3}{10}$ dollars, and the boy $\frac{7}{10}$ of a dollar a day; they received in all $9\frac{1}{10}$ dollars: how many days were they employed?

11. A person wishes to buy a clock, valued at $12\frac{9}{12}$ dollars; he earns $1\frac{7}{12}$ dollars a day, and his expenses are $\frac{10}{12}$ of a dollar: in what time can he save enough to buy the clock?

12. 9 times $6\frac{1}{2}$, are how many times $3\frac{1}{2}$?

13. 6 times $2\frac{1}{15}$, are how many times $1\frac{3}{15}$?

14. 9 are how many times 3 times $\frac{1}{2}$ of $\frac{3}{4}$?

15. $\frac{3}{5}$ of $\frac{1}{7}$ are contained how many times in $2\frac{9}{35}$?

16. The sum of $\frac{3}{4}$ and $\frac{1}{5}$, is how many times the difference of $\frac{1}{2}$ and $\frac{3}{10}$?

17. At $\frac{1}{3}$ of a dollar a pound, how many pounds of coffee can be bought for $\frac{3}{4}$ of a dollar?

18. If $\frac{1}{4}$ of a dollar will pay for a pound of butter, how many pounds can be bought for $\frac{7}{8}$ of a dollar?

19. A man divided $2\frac{4}{5}$ dollars among his children,

giving $\frac{7}{10}$ of a dollar to each: how many children were there?

20. If $\frac{3}{8}$ of a yard of silk will trim 1 bonnet, how many bonnets would $\frac{9}{12}$ of a yard trim?

21. How many boys, at $2\frac{1}{5}$ dimes a day, can be hired for $13\frac{2}{10}$ dimes?

22. In the course of a week, a person was employed 30 hours: how many days was he employed, at the rate of $7\frac{1}{2}$ hours a day?

23. How many days' labor, at $1\frac{1}{4}$ dollars a day, are required to earn $3\frac{1}{9}$ dollars?

24. If calico is worth $\frac{1}{8}$ of a dollar a yard, and muslin $\frac{1}{7}$ of a dollar a yard, how much calico must be given for 9 yards of muslin?

25. For how many days will $4\frac{4}{5}$ dollars support a person, whose daily expenses are $1\frac{3}{5}$ dollars?

26. How long would it take an army to move over $5\frac{3}{5}$ miles, at the rate of $2\frac{1}{3}$ miles per hour?

27. At $\frac{9}{25}$ of a dollar a dozen, how many dozen oranges can be bought for $2\frac{3}{5}$ dollars?

28. How long would it require an individual to save $14\frac{3}{4}$ dollars, if he saves $\frac{9}{20}$ of a dollar a day?

29. How many times is $\frac{2}{3}$ of a dollar contained in $\frac{7}{12}$ of a dollar?

30. How many times is $\frac{3}{4}$ contained in $\frac{7}{8}$? In $\frac{9}{5}$?

31. How many times must $\frac{7}{9}$ be taken, to equal $3\frac{4}{7}$? To equal $5\frac{1}{2}$?

32. How many bushels of potatoes, at $\frac{11}{16}$ of a dollar a bushel, will pay for 8 days' work, at $1\frac{1}{2}$ dollars a day?

33. A shoemaker owes for 2 barrels of flour, the price of which was $5\frac{3}{4}$ dollars a barrel; as he had no money, he agreed to pay in shoes, at $1\frac{7}{16}$ dollars a pair: how many pair were required?

34. A person, having $3\frac{5}{6}$ yards of the Atlantic telegraphic cable, divided it into pieces, $\frac{3}{18}$ of a yard in length : how many pieces did he obtain ?

35. If $\frac{1}{2}$ of $\frac{1}{6}$ of a yard of velvet is sufficient to trim a coat, how many coats can be trimmed out of $2\frac{3}{4}$ yards ?

NOTE.—The preceding analysis explains the manner of dividing one fraction by another, by reducing both to a common denominator

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LESSON XVII.

1. How much flour can be bought for $\frac{3}{5}$ of a dollar, if 1 barrel costs 6 dollars ?

ANALYSIS.—*As many barrels of flour can be bought for $\frac{3}{5}$ of a dollar, as 6 dollars are contained times in $\frac{3}{5}$ of a dollar : 6 is contained in $\frac{3}{5}$, $\frac{3}{30}$ times $= \frac{1}{10}$ times : Therefore, $\frac{1}{10}$ of a barrel of flour can be purchased for $\frac{3}{5}$ of a dollar.*

2. If meat is selling at 10 cents a pound, how many pounds will $1\frac{1}{2}$ cents buy ?

3. If 8 pounds of butter will supply a family for 1 week, how long will $\frac{9}{10}$ of a pound support the family ?

4. If 12 yards of muslin are required for a dress, how many dresses may be made out of $15\frac{7}{9}$ yards ?

5. If the weekly wages of a clerk are 9 dollars, how many weeks must he labor to earn $17\frac{3}{4}$ dollars ?

6. What is the quotient of $\frac{4}{12}$ divided by 4 ?

7. What is the quotient of $\frac{9}{12}$ divided by 3 ?

8. What is the quotient of $\frac{24}{8}$ divided by 12 ?

9. What is the quotient of $3\frac{1}{2}$ divided by 6 ?

10. What is the quotient of $5\frac{3}{4}$ divided by 7 ?

11. What is the quotient of $9\frac{4}{5}$ divided by 5 ?

12. What is the quotient of $12\frac{4}{3}$ divided by 8?

13. What is the quotient of $9\frac{5}{8}$ divided by 9?

14. What is the quotient of $5\frac{6}{7}$ divided by 7?

15. What is the quotient of $8\frac{3}{5}$ divided by 43?

16. What is the quotient of $\frac{2}{3}$ of $\frac{2}{7}$ divided by 7?

17. What is the quotient of $\frac{5}{6}$ of $\frac{1}{2}$ divided by 9?

18. Divide $\frac{2}{3}$ of $\frac{1}{2}$ by 6.   Divide $\frac{7}{2}$ of $\frac{1}{3}$ by 8.

19. What fraction, multiplied by 20, will produce $\frac{8}{13}$?

20. A father divided $\frac{7}{8}$ of a dollar equally among his five children: how much did each receive?

21. A grocer wishes to put $93\frac{2}{8}$ pounds of sugar into paper bags, each of which, except the last, to hold exactly 7 pounds: how many bags will he require, and how much will the last bag contain?

NOTE.—This analysis explains the method of dividing a fraction by a whole number. The operation is equivalent to multiplying the denominator of the fraction by the divisor.

LESSON XVIII.

1. If a book is worth $\frac{1}{4}$ of a dollar, how many books can be bought for 1 dollar?

ANALYSIS.—*As many books can be bought for 1 dollar, as $\frac{1}{4}$ of a dollar is contained times in 1 dollar. one-fourth of a dollar is contained in 1 dollar, 4 times: Therefore, 4 books can be bought for 1 dollar.*

2. To how many beggars can 1 dollar be distributed, if each receives $\frac{1}{6}$ of a dollar?

3. How many hours' labor must be given for 1 dollar, if the labor of 1 hour brings $\frac{1}{9}$ of a dollar?

4. How many times must $\frac{1}{7}$ be taken, to make 1.

5. How many times must $\frac{1}{8}$ be taken, to make 1.

6. A boy spends 1 dollar in buying oranges, at $\frac{1}{20}$ of a dollar apiece: how many does he buy?

7. How many times $\frac{1}{25}$ in 1? How many times $\frac{1}{16}$?

8. How many times $\frac{1}{12}$ in 1? How many times $\frac{1}{18}$?

9. How many times $\frac{1}{2}$ in 1? How many times $\frac{1}{21}$?

10. How many times $\frac{1}{3}$ in 4?

ANALYSIS.—$\frac{1}{3}$ *is contained in* 4, 4 *times as many times as in* 1: $\frac{1}{3}$ *is contained in* 1, 3 *times: Therefore,* $\frac{1}{3}$ *is contained in* 4, 4 *times* 3, *or* 12 *times.*

11. How many times is $\frac{1}{5}$ contained in 6? In 8?

12. How many times is $\frac{1}{7}$ contained in 5? In 9?

13. How many times is $\frac{1}{8}$ contained in 7? In 10?

14. How many times is $\frac{1}{12}$ contained in 11? In 12?

15. If an orange costs $\frac{1}{5}$ of a dime, how many oranges can be bought for 4 dimes? For 9 dimes?

16. A gentleman distributed 5 dollars among some boys, giving $\frac{1}{10}$ of a dollar to each: how many boys were there?

17. A boy received from his father, for good conduct ten dollars; each week he received $\frac{1}{2}$ of a dollar: in how many weeks had he earned the money?

18. A little girl deposited, for benevolence, in her savings-bank, whatever money she received. She received $\frac{1}{10}$ of a dollar per week; when the bank was opened, it contained 3 dollars: how many weeks had she been saving her money?

NOTE.--The quotient of a whole number divided by a fractional unit, is equal to the whole number multiplied by the denominator

LESSON XIX.

1. How many bushels of potatoes, at $\frac{2}{3}$ of a dollar a bushel, can be bought for 1 dollar?

ANALYSIS.—*As many bushels can be bought for* 1 *dollar as* $\frac{2}{3}$ *of a dollar is contained times in* 1 *dollar:* $\frac{2}{3}$ *is contained in* 1, $\frac{3}{2}$ *times: Therefore,* $\frac{3}{2}$ *bushels, equal to* $1\frac{1}{2}$ *bushels, can be bought for* 1 *dollar.*

2. How many yards of calico, at $\frac{3}{10}$ of a dollar a yard, can be bought for 1 dollar?

3. How many yards of muslin can be bought for 1 dollar, at $\frac{4}{25}$ of a dollar a yard?

4. How many melons, at $\frac{9}{50}$ of a dollar each, can be bought for 1 dollar?

5. A clock loses $\frac{3}{20}$ of an hour per week: in how many weeks will the clock have lost 1 hour?

6. A clock runs $\frac{2}{15}$ of an hour too fast, every week: in how many weeks will it have gained 1 hour?

7. A grocer gains $\frac{2}{45}$ of a dollar on a pound of butter: how many pounds must he sell, to gain 1 dollar?

8. How many times $\frac{3}{7}$ in 1?

9. How many times $1\frac{1}{2}$ in 1?

10. How many times $3\frac{1}{6}$ in 1?

11. How many times $\frac{2}{3}$ of $\frac{4}{7}$ in 1?

12. How many times $\frac{7}{8}$ of $2\frac{1}{3}$ in 1?

NOTE.—The terms of a fraction are said to be *inverted*, when the denominator is made the numerator, and the numerator the denominator.

The above analysis explains the manner of dividing 1 by any fraction. The quotient is equal to the fraction with its terms inverted.

13. If a pint of wine costs $\frac{2}{5}$ of a dollar, how many pints can be bought for 3 dollars?

ANALYSIS.—*As many pints can be bought for 3 dollars, as $\frac{2}{5}$ of a dollar is contained times in 3 dollars: $\frac{2}{5}$ is contained in 3, $\frac{15}{3}$ times = 5 times: Therefore, 5 pints of wine can be bought for 3 dollars.*

14. How many yards of silk, at $\frac{3}{4}$ of a dollar a yard, can be bought for 5 dollars?

15. If a quire of paper costs $\frac{3}{25}$ of a dollar, how much paper must be given for 3 volumes of Prescott's works, at 2 dollars a volume?

16. How many pounds of coffee, at $\frac{6}{25}$ of a dollar a pound, must be given for 12 pounds of tea, at $\frac{3}{4}$ of a dollar a pound?

17. How many times are $\frac{4}{7}$ contained in 6?

18. How many times are $2\frac{1}{5}$ contained in 3?

19. What is the quotient of 2 divided by $8\frac{2}{7}$?

20. What is the quotient of 8 divided by $3\frac{5}{9}$?

21. How many times are $\frac{3}{4}$ of $\frac{2}{5}$ contained in 10?

22. How many times are $\frac{2}{5}$ of 3 contained in $\frac{1}{4}$ of 28?

23. If $1\frac{2}{3}$ dollars will buy 2 yards of cloth, how many yards will 6 dollars buy?

24. For how many days' work will 16 half-dollars pay, at $1\frac{3}{5}$ dollars a day? At $2\frac{1}{6}$ dollars a day?

25. Two men are 15 miles apart, and are traveling in the same direction, the hinder one traveling 12 times as fast as the other: how far will the hinder travel before overtaking the other?

NOTE.—The above analysis explains the manner of dividing a whole number by a fraction. The quotient is equal to the whole number multiplied by the fraction, with its terms inverted.

LESSON XX.

1. How many bags of buckwheat, at $\frac{2}{3}$ of a dollar a bag, can be bought for $\frac{5}{4}$ dollars?

ANALYSIS.—*As many bags can be bought for $\frac{5}{4}$ dollars, as $\frac{2}{3}$ of a dollar is contained times in $\frac{5}{4}$ dollars: $\frac{2}{3}$ is contained in $\frac{5}{4}$, $1\frac{5}{8}$ times $= 1\frac{7}{8}$ times: Therefore, $1\frac{7}{8}$ bags of buckwheat can be bought for $\frac{5}{4}$ dollars.*

2. If a man can mow $\frac{7}{8}$ of an acre in 1 hour, how long will it take him to mow $\frac{5}{9}$ of an acre?

3. At $\frac{2}{5}$ of a dollar each, how many knives can be bought for $1\frac{6}{10}$ dollars?

4. At $\frac{1}{2}$ of a dollar each, how many pair of shoes must be given for 6 chairs, at $1\frac{5}{12}$ dollars apiece?

5. If a horse can run $\frac{3}{8}$ of a mile in 1 minute, how many minutes would be required, to run $\frac{5}{6}$ of a mile?

6. If John saves $\frac{1}{5}$ of a dollar, and James $\frac{1}{4}$ of a dollar, in a week, how long, at that rate, would it take them to save $1\frac{5}{20}$ of a dollar?

7. How many yards of cloth, at $1\frac{1}{2}$ dollars a yard, can be bought for $2\frac{4}{5}$ dollars?

8. If a horse eats $\frac{3}{8}$ of a peck of oats per day, how long will $3\frac{1}{6}$ pecks last him?

9. How many times are $\frac{4}{7}$ contained in $\frac{5}{4}$?

10. How many times are $\frac{3}{8}$ contained in $2\frac{1}{2}$?

11. How many times are $\frac{3}{7}$ contained in $\frac{5}{9}$?

12. How many times are $2\frac{1}{3}$ contained in $\frac{4}{5}$?

13. How many times are $\frac{5}{7}$ contained in $\frac{5}{8}$?

14. What is the quotient of $\frac{2}{3}$ divided by $3\frac{1}{3}$?

15. What is the quotient of $\frac{2}{7}$ divided by 2 ?

16. What is the quotient of $\frac{3}{8}$ divided by $4\frac{1}{2}$?

17. What is the quotient of $\frac{4}{9}$ divided by $3\frac{1}{3}$?

18. What is the quotient of $\frac{2}{5}$ divided by $2\frac{1}{10}$?

19. What is the quotient of $\frac{3}{4}$ divided by $6\frac{1}{2}$?

20. What is the quotient of $\frac{7}{5}$ divided by $2\frac{5}{3}$?

21. What is the quotient of $\frac{3}{10}$ divided by $2\frac{2}{5}$?

22. What is the quotient of $\frac{1}{3}$ of $\frac{2}{3}$ divided by $\frac{6}{7}$?

23. How many times are $\frac{2}{5}$ of 2 contained in $\frac{3}{4}$ of $\frac{2}{7}$?

24. A pleasure yacht was hired for $10\frac{1}{2}$ dollars a day; if each person paid $\frac{3}{8}$ of a dollar, how many persons were there in the company?

25. As the company proved to be too large, it was determined to charge each member $\frac{7}{8}$ of a dollar: how many were there then in the company?

26. In order to raise $6\frac{7}{8}$ dollars, how many contributors must there be, at $\frac{5}{16}$ of a dollar each?

27. If a miller takes, for toll, $\frac{6}{25}$ of a bushel, of every bushel of wheat that he grinds, how many bushels must he grind, that he may receive $9\frac{2}{3}$ bushels?

NOTE.—The above analysis explains the manner of dividing one fraction by another. The operation is equivalent to inverting the terms of the divisor, and then multiplying the terms of the fractions together

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LESSON XXI.

1. 2 is one-third of what number?

ANALYSIS.—*Two is one-third of 3 times 2: three times 2 are 6: Therefore, 2 is one-third of 6.*

2. Four is one-third of what number?

3. 5 is one-fifth of what number?

4. $2\frac{1}{2}$ is one-fourth of what number?

5. $1\frac{2}{3}$ is one-third of what number?

6. $3\frac{1}{3}$ is one-ninth of what number?

7. $10\frac{5}{6}$ is one-sixth of what number?

8. $8\frac{3}{4}$ is one-fourth of what number?

9 $5\frac{1}{10}$ is one-tenth of what number?

10. $2\frac{3}{4}$ is one-twelfth of what number?

11. $\frac{7}{9}$ is one-twentieth of what number?

12. $\frac{2}{3}$ of $\frac{4}{7}$ is one-fifth of what number?

13. $\frac{5}{6}$ of $2\frac{1}{3}$ is one-sixth of what number?

14. Eight is $\frac{2}{3}$ of what number?

ANALYSIS.—*Since* 8 *is* $\frac{2}{3}$ *of some number, one-third of that number is one-half of* 8, *or* 4: *three times* 4, *or* 12, *is the number whose third is* 4: *Therefore* 8, *is* $\frac{2}{3}$ *of* 12.

15.   12 is $\frac{3}{4}$ of what number?

16.   16 is $\frac{4}{5}$ of what number?

17.   30 is $\frac{6}{7}$ of what number?

18.   32 is $\frac{8}{9}$ of what number?

19.   15 is $\frac{5}{9}$ of what number?

20.   12 is $\frac{4}{7}$ of what number?

21.   22 is $1\frac{1}{12}$ of what number?

22.   27 is $\frac{9}{10}$ of what number?

23.   21 is $\frac{7}{9}$ of what number?

24.   15 is $\frac{4}{5}$ of what number?

25.   17 is $\frac{7}{8}$ of what number?

26.   26 is $\frac{5}{12}$ of what number?

27. $\frac{4}{5}$ is $\frac{2}{3}$ of what number?

28. $3\frac{1}{2}$ is $\frac{6}{7}$ of what number?

29. $\frac{9}{10}$ is $\frac{6}{11}$ of what number?

30. $\frac{3}{4}$ of $\frac{2}{3}$ is $\frac{5}{9}$ of what number?

31. 16 is 5 times what number?

ANALYSIS.—16 *is 5 times* $\frac{1}{5}$ *of* 16: $\frac{1}{5}$ *of* 16 *is* $3\frac{1}{5}$: *Therefore,* 16 *is 5 times* $3\frac{1}{5}$.

32. 48 is 6 times what number?

33. 39 is 3 times what number?

34. 56 is 9 times what number?

35. 21 is 5 times what number?

36. 75 is 8 times what number?

37. 54 is 8 times what number?

38. 95 is 9 times what number?

39. $\frac{5}{6}$ is 7 times what number?

40. $3\frac{4}{9}$ is 6 times what number?

41. James gave 9 cents for a slate, which was $\frac{3}{4}$ of his money: how much had he?

42. A man bought a cow for 30 dollars, which was $\frac{3}{5}$ of his money: how much had he?

43. A lady was married at 20 years of age, which was the half of $\frac{3}{5}$ of her husband's age: how old was the husband?

44. John gave 36 cents for a knife, which was $\frac{6}{7}$ of what he gave for a sled: how much did he give for his sled?

45. Charles gave $10\frac{5}{6}$ cents for his kite, which was 5 times what he paid for his top: how much did he pay for his top? How much for both?

46. Two men agreed to build a wall; one man built 16 rods, which was $\frac{4}{5}$ of what the other built: how much

did the second build, and what was the whole length of the wall?

47. A person always saved, of his monthly salary, 15 dollars; his monthly expenses were $\frac{5}{7}$ of his salary: what was the salary?

48. A boy received $\frac{5}{8}$ of a dollar from his father, and $\frac{1}{3}$ of a dollar from his mother, to buy a pair of skates: he lacked $\frac{1}{3}$ of the cost of the skates: what was their cost?

49. $\frac{3}{4}$ of a dollar is $3\frac{1}{2}$ times the value of a pineapple: what was the value of the pineapple?

50. A man bought a horse for 100 dollars; he also bought a carriage; $\frac{4}{5}$ of what he paid for the horse, was $\frac{2}{3}$ of what he paid for the carriage: how much did he pay for the carriage?

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LESSON XXII.

1. 25 is 5 eighths of how many times 7?

ANALYSIS.—*Since* 25 *is* $\frac{5}{8}$ *of some number, one-eighth of that number is* 5, *and the number is* 8 *times* 5, *or* 40 : 40 *is* 7 *times* $\frac{1}{7}$ *of* 40, *which is* $5\frac{5}{7}$: *Therefore,* 25 *is* $\frac{5}{8}$ *of* $5\frac{5}{7}$ *times* 7.

2. 63 is $\frac{7}{9}$ of how many times 8?

3. 36 is $\frac{4}{7}$ of how many times 6?

4. 45 is $\frac{5}{6}$ of how many times 5?

5. 84 is $\frac{7}{8}$ of how many times 9?

6. 27 is $\frac{3}{9}$ of how many times 10?

7. 42 is $\frac{7}{3}$ of how many times 5?

8. 64 is $\frac{8}{5}$ of how many times 3?

9. 32 is $\frac{3}{8}$ of how many times 11?

10. $\frac{4}{5}$ is $\frac{6}{7}$ of how many times 3 ?

11. $4\frac{2}{7}$ is $\frac{3}{4}$ of how many times 5 ?

12. $\frac{9}{10}$ is $\frac{8}{9}$ of how many times $\frac{2}{3}$?

13. $1\frac{1}{8}$ is $\frac{5}{12}$ of how many times $2\frac{1}{3}$?

14. 6 sevenths of 21, are 3 fifths of what number ?

ANALYSIS.— *One-seventh of 21 is 3, and six-sevenths of it are 6 times 3, or 18 : 18 are three-fifths of 30 : Therefore, $\frac{6}{7}$ of 21 are $\frac{3}{5}$ of 30.*

15. $\frac{8}{9}$ of 27, is $\frac{4}{7}$ of what number ?

16. $\frac{3}{4}$ of 40, is $\frac{6}{10}$ of what number ?

17. $\frac{5}{8}$ of 64, is $\frac{8}{9}$ of what number ?

18. $\frac{2}{3}$ of 42, is $\frac{5}{12}$ of what number ?

19. $\frac{7}{10}$ of 80, is $\frac{8}{9}$ of what number ?

20. $\frac{4}{5}$ of 60, is $\frac{6}{7}$ of what number ?

21. $\frac{5}{6}$ of 48, is $\frac{7}{8}$ of what number ?

22. $\frac{3}{7}$ of 21, is $\frac{2}{3}$ of what number ?

23. $\frac{4}{9}$ of 81, is $\frac{5}{8}$ of what number ?

24. $\frac{7}{5}$ of 45, is $\frac{9}{7}$ of what number ?

25. $\frac{4}{5}$ of $2\frac{1}{3}$, is $\frac{3}{4}$ of what number ?

26. $\frac{5}{12}$ of $\frac{1}{4}$, is $\frac{2}{5}$ of what number ?

27. $\frac{1}{10}$ of $\frac{2}{3}$, is $\frac{4}{7}$ of what number ?

28. $3\frac{1}{4}$ times $\frac{2}{7}$, is $\frac{2}{3}$ of what number ?

29. $\frac{5}{9}$ of 36, is $\frac{4}{5}$ of how many times 5 ?

30. $\frac{4}{7}$ of 56, is $\frac{8}{9}$ of how many times 7 ?

31. $\frac{3}{4}$ of 24, is $\frac{6}{7}$ of how many times 4 ?

32. $\frac{5}{8}$ of 48, is $\frac{5}{9}$ of how many times 9 ?

33. $\frac{4}{3}$ of 30, is $\frac{8}{11}$ of how many times 8 ?

34. $\frac{5}{10}$ of 72, is $\frac{4}{9}$ of how many times 6 ?

LESSON XXIII.

1. $\frac{3}{7}$ of 56, is $\frac{8}{9}$ of 3 times what number?

ANALYSIS.—*One-seventh of 56 is 8, and three-sevenths of it are 3 times 8, or 24: 24 is eight-ninths of 27, which is 3 times 9: Therefore, $\frac{3}{7}$ of 56 is $\frac{8}{9}$ of 3 times 9.*

2. $\frac{5}{6}$ of 54, is $\frac{5}{8}$ of 9 times what number?

3. $\frac{4}{5}$ of 30, is $\frac{3}{4}$ of 8 times what number?

4. $\frac{2}{9}$ of 81, is $\frac{3}{11}$ of 4 times what number?

5. $\frac{5}{8}$ of 56, is $\frac{7}{9}$ of 6 times what number?

6. $\frac{4}{3}$ of 36, is $\frac{6}{5}$ of 10 times what number?

7. $\frac{9}{10}$ of 90, is $\frac{6}{4}$ of 8 times what number?

8. $\frac{6}{2}$ of 30, is $\frac{9}{10}$ of 20 times what number?

9. $\frac{7}{9}$ of 108, is $\frac{7}{12}$ of 8 times what number?

10. $\frac{2}{3}$ of $5\frac{1}{4}$, is $\frac{3}{5}$ of 7 times what number?

11. $\frac{4}{7}$ of $\frac{5}{6}$, is $\frac{2}{3}$ of 6 times what number?

12. $\frac{8}{9}$ of $\frac{27}{28}$, is $\frac{12}{13}$ of 2 times what number?

13. $\frac{5}{8}$ of 32, is $\frac{4}{5}$ of how many sixths of 18?

ANALYSIS.—*One-sixth of 18 is 3. Hence, the question takes the form,*

$\frac{5}{8}$ *of 32, is $\frac{4}{5}$ of how many times 3?*
which is answered by the last analysis: Therefore, $\frac{5}{8}$ of 32, is $\frac{4}{5}$ of $8\frac{1}{3}$ times $\frac{1}{6}$ of 18.

14. $\frac{6}{7}$ of 56, is $\frac{8}{9}$ of how many fourths of 24?

15. $\frac{8}{5}$ of 40, is $\frac{4}{5}$ of how many sixths of 36?

16. $\frac{4}{3}$ of 36, is $\frac{8}{12}$ of how many fifths of 45?

17. $\frac{2}{5}$ of 75, is $\frac{5}{7}$ of how many ninths of 54?

18. $\frac{3}{2}$ of 40, is $\frac{6}{12}$ of how many tenths of 80 ?
19. $\frac{7}{9}$ of 72, is $\frac{8}{5}$ of how many thirds of 24 ?
20. $\frac{2}{3}$ of $\frac{6}{7}$, is $\frac{4}{9}$ of how many halves of 12 ?
21. $\frac{7}{8}$ of $1\frac{6}{17}$, is $\frac{2}{7}$ of how many fourths of $2\frac{1}{2}$?
22 $\frac{5}{9}$ of $\frac{4}{5}$, is $\frac{3}{4}$ of how many fifths of $\frac{2}{3}$?
23 $\frac{3}{4}$ of 14, is $\frac{5}{6}$ of how many sevenths of 21 ?
24. $\frac{7}{10}$ of 21, is $\frac{3}{5}$ of how many ninths of 18 ?
25. $\frac{4}{5}$ of 30, is $\frac{4}{5}$ of how many times $\frac{2}{3}$ of 21 ?
26. $\frac{6}{3}$ of 27, is $\frac{6}{9}$ of how many times $\frac{1}{10}$ of 90 ?
27. $\frac{8}{9}$ of 63, is $\frac{7}{12}$ of how many times $\frac{4}{8}$ of 24 ?
28. $\frac{7}{6}$ of 54, is $\frac{9}{10}$ of how many times $\frac{2}{9}$ of 45 ?
29. $\frac{5}{2}$ of 24, is $\frac{5}{8}$ of how many times $\frac{4}{7}$ of 28 ?
30. $\frac{9}{10}$ of 70, is $\frac{7}{6}$ of how many times $\frac{3}{9}$ of 27 ?
31. $\frac{4}{3}$ of 36, is $\frac{4}{9}$ of how many times $\frac{2}{7}$ of 42 ?
32. $\frac{5}{9}$ of 72, is $\frac{4}{5}$ of how many times $\frac{5}{12}$ of 60 ?
33. $\frac{7}{8}$ of 64, is $\frac{8}{7}$ of how many times $\frac{3}{8}$ of 32 ?
34. $\frac{10}{4}$ of 36, is $\frac{9}{3}$ of how many sevenths of 63 ?

LESSON XXIV.

PROMISCUOUS QUESTIONS.

1. If $\frac{2}{3}$ of a yard of cloth cost 4 dollars, what will one yard cost ?

2. If $\frac{3}{4}$ of a yard are 27 inches, what is the length of 1 yard ?

3. If 15 dollars will pay for the rent of a house $\frac{3}{5}$ of a month, how much will pay for the month ?

4. A horse was sold for 45 dollars, which was $\frac{3}{5}$ of its cost : what was the cost of the horse ?

5. A lady bought $\frac{5}{8}$ of a yard of silk for 60 cents : what was the value of the silk a yard ?

6. If $1\frac{1}{4}$ pounds of tea cost 80 cents, what is the cost of one pound?

7. A storekeeper gained 12 dollars in the sale of a package of books, which was $\frac{2}{7}$ of the cost: what was the cost, and for what amount were the books sold?

8. A drover sold a horse for 90 dollars, which was $\frac{3}{7}$ of its cost: what was its cost?

9. A son's age is 20 years, and it is $\frac{5}{12}$ of the father's age: what is the age of the father?

10. A ship-owner sold $\frac{1}{2}$ of his share in a ship, for 2000 dollars; he owned $\frac{2}{5}$ of the vessel: at this rate, what was the value of the vessel?

11. In a pasture, there are 45 sheep, which is $\frac{3}{4}$ of the number of cows: how many cows are there?

12. A lady married at 20, which was $\frac{4}{5}$ of her husband's age: how old was the husband?

13. Two men agreed to build a wall: one man built 24 rods, which was $\frac{4}{7}$ of what the other built: how much did the second build?

14. 8 is $\frac{2}{5}$ of what number?

15. 18 is $\frac{3}{8}$ of what number?

16. 24 is $\frac{4}{9}$ of what number?

17. An army, besieged, is put on short allowance; each man receives, per day, 12 ounces of bread, which is $\frac{4}{7}$ of a full ration, and 10 ounces of meat, which is $\frac{5}{9}$ of a full ration: what are the daily rations?

18. A merchant sold flour at 7 dollars a barrel, and thereby gained $\frac{1}{4}$ of the cost: what was the cost?

19. By selling silk at 75 cents a yard, a merchant gained $\frac{1}{5}$ of the cost: what was the cost?

20. At 50 cents apiece for chairs, a merchant lost $\frac{1}{9}$ of the cost: what was the cost?

21. How much cloth, at 4 dollars a yard, must be given for a hogshead of sugar, if $\frac{4}{7}$ of it cost 48 dollars?

22. A pole is $\frac{2}{5}$ in the water, $\frac{1}{4}$ in the mud, and 14 feet out of the water: how long is the pole?

23 John's age is $\frac{2}{3}$ of William's, and the sum of their ages, diminished by 5, is equal to 70: what is the age of each?

24. Two boys counting their marbles, one said he had 16; the other said, $\frac{3}{8}$ of yours is exactly $\frac{2}{7}$ of mine; now, if you will tell me how many I have, I will give you the difference between yours and mine: how many had he?

25. A person, being asked his age, said, that $\frac{3}{4}$ of 80 was $\frac{6}{7}$ of 5 times his age: what was his age?

26. James, being asked how many credit marks he had, said: If $\frac{1}{3}$ of the number be taken from $\frac{1}{2}$ of the number, the remainder will be $2\frac{1}{2}$ times 4: how many credits had he?

27. A tailor cut off $\frac{3}{5}$ of a piece of cloth, after which, he cut off 4 yards, which was $\frac{1}{3}$ of the first remainder: how many yards were there in the piece?

28. A man bought a horse for 150 dollars; $\frac{4}{5}$ of what the horse cost, was $\frac{1}{3}$ of what he paid for a carriage: how much did the carriage cost him?

29. The insurance on a house is 600 dollars, and $\frac{2}{3}$ of that is $\frac{4}{5}$ of 3 times the value of the furniture: what is the furniture worth?

30. Bought 45 yards of cloth, and sold $\frac{4}{9}$ of it for 20 dollars, which was $\frac{5}{6}$ of what the whole cost: what would be the gain on the whole, at the same rate?

31. A gentleman left to his eldest son 300 dollars, which was $\frac{3}{4}$ of what the second son had, and twice the second son's share was just 4 times what the third son received: how much was the father worth?

32. A gambler lost $\frac{3}{4}$ of his money in play; he then won 30 dollars, which was $\frac{5}{6}$ of what he lost: how much money had he when he began to play?

33. A man had sheep in 3 pastures; in the first he had 42, which was $\frac{7}{8}$ of what he had in the second; $\frac{5}{3}$ of what he had in the second, was just 4 times what he had in the third: how many had he in each field?

34. $\frac{4}{7}$ of A's age is $\frac{4}{5}$ of B's, and 3 times B's is $\frac{5}{2}$ of C's: how old are A and B, if C is 24 years old?

35. A house is worth 600 dollars, and $\frac{5}{6}$ of its value is $\frac{1}{5}$ of $2\frac{1}{2}$ times the value of the farm on which it stands: what is the value of the farm?

36. A boy, being asked his age, said, that 9 years was 3 years more than $\frac{3}{4}$ times $\frac{4}{7}$ of his age: what was his age?

37. The contents of a certain store cost 1000 dollars, and $\frac{2}{5}$ of the entire cost is $\frac{4}{9}$ of 3 times what the cloths cost: what was the cost of the cloths?

38. Fort Plain is 56 miles from Albany; $\frac{5}{7}$ of this distance is $\frac{4}{5}$ times $\frac{1}{5}$ the distance from Albany to Rochester: what is the distance from Albany to Rochester?

39. Buffalo is 325 miles from Albany, and $\frac{3}{5}$ of this distance is $3\frac{3}{4}$ times $\frac{2}{3}$ of the distance from Rochester to Buffalo: what is the distance?

40. By Erie Railroad, Jersey City is 236 miles from Owego; $\frac{3}{4}$ of this distance is 15 miles less than 6 times the distance from Jersey City to Suffern: how many times is $\frac{2}{3}$ of a dozen miles contained in this last distance?

41. A man had $\frac{5}{6}$ of his money stolen from him; the thief was caught, but not until he had spent $\frac{2}{3}$ of it; the remainder, 50 dollars, was given back: how much money had he at first?

SECTION SIXTH.

UNITS OF NUMBER.

The *base* of every number, is the unit 1. There are eight kinds of units; they are,

1. Units of Abstract Number.
2. Units of Currency.
3. Units of Length.
4. Units of Surface.
5. Units of Volume.
6. Units of Weight.
7. Units of Time.
8. Units of Angular Measure.

What is the base of every number? How many kinds of units are there? Name them.

SUGGESTIONS.

1. The eight kinds of Units, named above, are the elements of Mathematical Science, and no knowledge of that science can be acquired, without apprehending, clearly, the nature and relations of these units.

2. Let the teacher, therefore, be very careful, to give the pupil a distinct idea of the leading unit of each kind.

3. To aid the teacher in this, the dollar, the unit of currency; the inch, one of the units of length; the square inch, one of the units of surface; and the cubic inch, one of the units of volume, have been made, in their exact size, and placed in their respective Tables. The teacher

should exhibit to every class, the gallon measure, the half-bushel, and the pound weight; and should also mark the degree, in angular measure, on the blackboard.

LESSON I.

UNITS OF ABSTRACT NUMBERS.

An *abstract* number, is one in which the *kind* of unit is not named; as, 30, 50, &c.

A *denominate* number, is one in which the *kind* of unit is named; as, 3 days, 5 dollars, &c.

The abstract units take the following names: Units of the first order, or simply, units; units of the 2d order, or tens; units of the 3d order, or hundreds; units of the 4th order, or thousands; units of the 5th order, or ten thousands; units of the 6th order, or hundred thousands; units of the 7th order, or millions, &c.

A *scale*, is the number denoting how many units of one order or denomination, make one of the next higher.

TABLE.

10 Units............make	{	1 Ten, or 1 unit of 2d order = 10.
10 Tens	"	1 Hundred, or 1 unit of 3d order = 100.
10 Hundreds	"	1 Thousand, or 1 unit of 4th order = 1000.
10 Thousands	"	1 Ten thousand, or 1 unit of 5th order = 10000.
10 Ten thousands	"	1 Hundred thousand, or 1 unit of 6th order = 100000.
10 Hundred thousand	"	1 Million, or 1 unit of 7th order = 1000000.
&c.,		&c.

What is an abstract number? What is a denominate number? What is a unit of the 2d order? Of the 4th order? What is the scale, in abstract numbers?

LESSON II.

UNITS OF CURRENCY.

Currency is a fixed system of money, represented by coins, by Treasury notes, and Bank notes. Every civilized country has a currency, and, consequently, a unit of currency.

In the United States, the leading unit is 1 Dollar; in England, it is 1 Pound Sterling, equal to 4 dollars and eighty-four cents; and in France, it is 1 Franc, equal to 18 and 3-quarter cents.

UNITED STATES CURRENCY.

10 Mills (*m.*) ......make	1 Cent ....*ct.*
10 Cents .... "	1 Dime............*d.*
10 Dimes .... "	1 Dollar............$.
10 Dollars........ "	1 Eagle ....*E.*
2 Eagles .... "	1 Double Eagle......*D. E.*

1 Dollar: the leading unit of United States currency. Exact size ....

1. What are the units of U. S. currency? What is the scale?

2. How many mills are there in 2 cents? In 4? In 6? In 3? In one-half of a cent? In $\frac{1}{5}$ of a cent?

3. How many cents are there in 30 mills? In 70? In 90? In 20? In 60?

4. How many cents are there in 5 dimes? In 8? In $\frac{1}{5}$ of a dime? In 9? In 12? In $2\frac{1}{2}$ dimes?

5. In 20 cents, how many dimes? In 60? In 90? In 50? In 30 cents, how many half-dimes?

6. How many dimes in 3 dollars? In 6? In $\frac{1}{2}$ of a dollar? In $2\frac{1}{5}$ dollars? In 7?

NOTE.—Dollars, cents, and mills are thus written, $7.657, and read, 7 dollars, 65 cents, and 7 mills.

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MEASURE, OR RATIO OF NUMBERS.

1. How many times is 1 cent contained in 1 dime = 10 cents? How many times is 1 cent contained in 1 dollar = 100 cents?

2. To *measure* a thing, is to find how many times it contains some other thing of the same kind, regarded as a *standard*. Thus, 1 dime, measured by 1 cent, as a standard, gives 10. Ten is called, the *ratio* of 1 cent to 1 dime; hence,

The *ratio* of one number to another, is the quotient which arises by dividing by the standard.

3. What is the result of measuring 1 dollar by 1 cent? How many times does 1 dollar contain the standard? What is the ratio of 1 cent to 1 dollar = 100 cents?

4. What is the result of 2 dollars measuring 4 dollars? What is the ratio of 2 to 4? What is the ratio of 6 to 12? Of 4 to 16? Of 15 to 45?

Note.—When the standard is less than the number measured, the ratio will be a whole number, or a mixed number. In this case, we say, "How many times does the number measured contain the standard?" As, how many times is 7 as great as 2? *Ans.* $3\frac{1}{2}$.

When the number measured is less than the standard, the ratio will be a proper fraction. In this case, we say, "What part of the standard, is the number measured?" Thus, if we measure 1 cent by the dime, as a standard, we say, "1 cent is what part of a dime?" or, "What part of a dime, is 1 cent?" *The standard is always the divisor.*

5. What part of a dollar is 50 cents? What part of a dollar is 25 cents? 20 cents? 10 cents? 5 cents? What is the standard?

6. Five is what part of 6? Which is the standard? Three is what part of 10? 9 is what part of 27?

What part of 16 is 7? What is the ratio of 16 to 7? Of 27 to 5? What part of 36 is 6? What is the ratio 36 to 6?

Note.—The number which forms the *part*, is the measured number; the number of which it is a part, is the standard

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ENGLISH CURRENCY.

The leading unit of the English currency, is the English pound sterling, or sovereign, valued at 4 dollars and 84 cents.

4 Farthings (*far.*)	...... make	1 Penny	........*d.*
12 Pence	.... "	1 Shilling	......*s.*
20 Shillings	.... "	1 Pound	........£.
21 Shillings	.... "	1 Guinea	.......*G.*

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1. What are the units of English currency? What is the scale in passing from farthings to pence? From pence to shillings? From shillings to pounds? From shillings to guineas?

2. How many farthings are there in 2 pence? In 5? In 3? In 7? In one-half of a penny? In $\frac{1}{4}$ of a penny? In $2\frac{1}{2}$ pence? In $8\frac{1}{4}$ pence?

3. How many pence in 3 shillings? In 5? In 4? In $\frac{1}{3}$ of a shilling, how many pence? In 9 shillings? In $2\frac{1}{2}$? In $\frac{3}{4}$ of a shilling? In $\frac{5}{6}$ of a shilling?

4. In 2 pounds, how many shillings? In 4? In $6\frac{1}{2}$? In $\frac{1}{5}$ of a pound? In $3\frac{1}{2}$? In $7\frac{1}{4}$?

5. How many pence are there in 16 farthings? In 24? In 12? In 48? In 13? In 15?

6. How many shillings are there in 24 pence? In 36? In 60? In 96? In 30? In 40?

7. How many pounds are there in 40 shillings?

8. How many guineas are there in 42 shillings?

9. How many farthings are there in 1 shilling? In 3 shillings? In 2 shillings and 6 pence?

10. How many pence are there in 1 pound? In 2?

11. How many shillings in £3 6s.? In £4 15s.?

12. One farthing is what part of a penny?

13. What part of a shilling is 3 farthings?

14. What part of a shilling is 6 pence? 5 pence?

15. What part of a pound is 1 shilling? What part of a pound is 5 shillings?

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LESSON III.

UNITS OF LENGTH.

The units, most used for the measurement of length, are, 1 foot, 1 yard, and 1 rod. There are two tabular systems of units of length, called, Linear Measure, and Cloth Measure.

LINEAR MEASURE.

12	Inches (*in.*).....make	1 Foot ....*ft.*
3	Feet .... "	1 Yard ....*yd.*
5½	Yards, or 16½ feet "	1 Rod ....*rd.*
40	Rods .... "	1 Furlong.....*fur.*
8	Furlongs........ "	1 Mile.........*mi.*
3	Miles .... "	1 League ......*L.*
60	geographical, or } "	1 Degree ......*deg.*, or °.
69½	statute Miles... }	
360	Degrees .... "	Circumference of the Earth.

The unit,   1 Inch.

NOTE.—Let the teacher exhibit the foot and yard.

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1. What are the units of Linear Measure? What is the scale in passing from inches to feet? From feet to yards? From yards to rods? From feet to rods? From rods to furlongs? From furlongs to miles? From miles to leagues? From miles to degrees?

2. How many inches in 2 feet? In 5 feet? In 3½?

3. How many feet in 4 yards? In 6⅕ *yd.*? In 10½?

4. How many feet in 24 inches? In 100 *in.*?

5. How many yards in 15 *ft.*? In 20 *ft.*? In 28 *ft.*? How many yards in 108 inches? In 96 *in.*? In 132 *in.*?

6. How many rods are there in 2 furlongs? In 4¼ *fur.*? In 2½ *fur.*? How many furlongs in 3 miles?

7. How many miles in 24 furlongs? In 56 *fur.*?

8. How many inches in 3 *yd* 2 *ft.*? In 4 *yd* 1 *ft*?

9. What is the ratio of 1 inch to 1 foot = 12 inches? What is the ratio of 1 foot to 1 yard? To 1 rod? What is the ratio of 1 yard to 1 rod?

10. What is the ratio of 1 rod to 1 furlong = 40 rods? What is the ratio of 1 rod to 1 mile?

11. What part of a foot is 1 inch? What part is 1 foot, of a yard? Which is the standard?

12. What part of a mile is 2 rods? What is the ratio of 1 mile to 2 rods? To 80 rods?

13. What is the ratio of 1 mile to 1 league? What is the ratio of 1 league to 1 mile?

14. What part of a mile is 1 furlong? What is the ratio of 1 mile to 1 furlong? What is the ratio of 1 furlong to 1 mile? What part of 100 is 20?

CLOTH MEASURE.

$2\frac{1}{4}$ Inches (*in.*)....make	1 Nail............	*na.*
4 Nails.......... "	1 Quarter.........	*qr.*
4 Quarters....... "	1 Yard...........	*yd.*
3 Quarters....... "	1 Ell Flemish......	*E. Fl.*
5 Quarters....... "	1 Ell English......	*E. E.*
6 Quarters....... "	1 Ell French......	*E. Fr.*

----

1. What are the units of Cloth Measure? What is the scale in passing from inches to nails? From nails to quarters? From quarters to yards? From quarters to Ells Flemish? To Ells English? To Ells French?

2. How many inches are there in 2 nails? In 4 *na.*?

3. How many nails in 3 quarters of a yard? In $6\frac{1}{2}$ *qr.*?

4. In 6 yards, how many quarters? In 3 *yd.*? In $7\frac{1}{2}$?

5. How many quarters are there in 16 nails? In 48? In 32 *na.*? How many yards in 24 *na.*? In 36 *na.*?

6. How many quarters in 6 Ells Flemish? In 7 Ells English? In 5 Ells French? In 8 *E. Fl.*?

7. How many Ells English are equal to 10 yards? How many yards are equal to 12 Ells French? In 4 *E. E.*

3 *qr.*, how many quarters are there? How many nails? In 7 Ells Flemish 2 quarters?

8. What part of a nail is 1 inch?

ANALYSIS.—*Since the standard is* 1 *nail, or* 2¼ *inches, the part is equal to* 1 *divided by* 2¼: 1 *divided by* 2¼, *is* $\frac{4}{9}$: *Therefore,* 1 *inch is* $\frac{4}{9}$ *of a nail.*

9. A yard is what part of a nail? What part of a quarter of a yard is 1 nail?

10. What part of a yard is the Ell Flemish? 1 yard is what part of the Ell English? What, of the Ell French? What part of the Ell English is the Ell French?

11. What is the ratio, if the Ell English measures the Ell French? What, if the Ell French measures the Ell English?

LESSON IV.

UNITS OF SURFACE.

The units of this measure are squares, having linear units for their sides. A square is a figure, that has four equal sides, and four equal angles.

If each side is an inch long, the square is called, a square inch; if a foot long, it is called, a square foot; if a yard long, a square yard; if a mile, a square mile.

A surface has two dimensions, length and breadth. The measure of a surface is expressed in squares.

1
Square Inch.
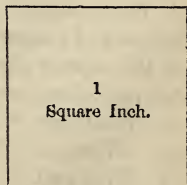
SQUARE MEASURE.

144	Square Inches (*sq. in.*) make	1 Square Foot	....*sq. ft.*
9	Square Feet .... "	1 Square Yard	...*sq. yd.*
30¼	Square Yards .... "	1 Sq. Rod, or Perch.	*P.*
40	Sq. Rods, or Perches . "	1 Rood	...*R.*
4	Roods............. "	1 Acre	.*A.*
640	Acres .... "	1 Square Mile	.....*sq. m.*

1. What are the units of this measure? What is the scale in passing from square inches to square feet? From square feet to square yards? From square yards to square rods? From square rods to roods? From roods to acres? From acres to miles? How many sides has a square? Are they equal, or unequal? How many dimensions has a square? How many dimensions has a field?

2. How many square inches in 2 square feet? In 3?

3. How many square feet in 3 square yards? In 5? In 9? In 7? In 2½?

4. How many square yards in 36 square feet? In 18? In 45? In 81? In 63? In 108?

5. In 2 square rods, how many square yards? In 4?

6. How many square rods in 3 roods? In 6? In 4?

7. How many roods in 80 square rods? In 160?

8. What part of a square yard is 1 square foot? What part of a square foot is 1 square inch? 5 *sq. in.*?

9. One square yard is what part of a square rod? What part of an acre is 1 rood?

10. What part of an acre is 1 square rod? 9 square rods? What part of a square yard is a square foot?

11. What part of a square mile is 80 acres? What part is 1 acre? 5 acres?

12. What is the ratio of 1 rod measuring an acre? Of 1 acre measuring a rood?

13. What is the ratio of a square inch to a square foot? Of a square yard to a square foot?

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LESSON V.

UNITS OF VOLUME.

A *volume*, is a limited portion of space. Space has three dimensions,—length, breadth, and thickness. Volume has the same. The most familiar unit of volume is a cube.

A cube, is a solid having 6 equal square faces. If each face is a square inch, the cube is called, a *cubic inch;* if the face is a square foot, it is called, a *cubic foot;* if a sq. yard, a *cubic yard.*
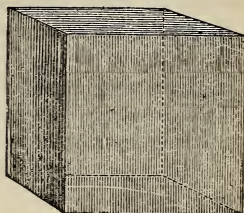
1 Cubic Inch.

The cube is the measuring unit of all solids.

A second unit of volume, is the gallon measure, used for the measurement of all kinds of fluids.

A third unit of volume, is the bushel, used for the measurement of dry articles, as grain, fruit, salt, coal, &c.

What is a volume? How many dimensions has a volume? What are they? How many dimensions has a solid? What is a cube? What is a cubic foot? What unit is used in measuring liquids? In measuring dry articles?

CUBIC MEASURE.

1728 Cubic Inches (*cu. in.*) make 1 Cubic Foot... *cu. ft.*
  27 Cubic Feet .... " 1 Cubic Yard ... *cu. yd.*
  40 Cubic Feet of round, or }
  50 Cu. Feet of hewn Timber} 1 Ton .... *T.*
  42 Cubic Feet .... " 1 Ton of Shipping. *T.*
  16 Cubic Feet .... " 1 Cord Foot...... *C. ft.*
   8 Cord Feet, or}
 128 Cubic Feet   } ..... " 1 Cord .... *C.*

1. What are the units of Cubic Measure? What is the scale in passing from cubic inches to cubic feet? From cubic feet to cubic yards? From cubic feet to tons? From cubic feet to cord feet? From cord feet to cords? From cubic feet to cords?

2. How many cubic feet in 2 cubic yards? In 3?

3. In 2 tons of hewn timber, how many cubic feet?

4. How many cord feet in 32 cubic feet? In 48?

5. How many cords in 16 cord feet? In 40? In 72?

6. How many cubic feet in 2 cords? In ½ of a cord?

7. What part of a cubic foot is 1 cubic inch? What part is 9 cubic inches?

8. What part of a cubic yard is 12 cubic feet? What part is 1 cubic foot? 19 cubic feet?

9. What part of a ton of round timber is 2 cubic feet?

10. What part of a ton of hewn timber is 25 cubic feet? What part is 15 cubic feet? 12½ cubic feet?

11. What part of a cord is 16 cubic feet? What part of a cord foot is 9 cubic feet?

12. What part of a cord is 5 cord feet? What part is 6 cubic feet? 64 cubic feet?

13. What is the ratio of a cubic foot to a cubic yard? Of a cubic yard to a cubic foot?

LIQUID MEASURE.

The leading unit of this measure, is the *gallon.*

4	Gills (*gi.*) ....make	1 Pint ....*pt.*
2	Pints .... "	1 Quart.........*qt.*
4	Quarts .... "	1 Gallon ....*gal.*
31½	Gallons .... "	1 Barrel ....*bar.*
42	Gallons .... "	1 Tierce ....*tier.*
63	Gallons, or 2 Barrels "	1 Hogshead ....*hhd.*
2	Hogsheads.......... "	1 Pipe.........*pi.*
2	Pipes, or 4 Hogsheads "	1 Tun ....*tun.*

1. What are the units of Liquid Measure? What is the scale in passing from gills to pints? From quarts to gallons? From gallons to hogsheads? From gallons to barrels? From barrels to hogsheads? From hogsheads to tuns?

2. In 3 pints, how many gills? In 6? In 9? In 4½?

3. How many pint measures would 16 gills of water fill? How many would 36? 20? 56?

4. How many quarts are equal to 2 gallons? To 4? To 7½? To 9¼? To 5½? To 7¼?

5. How many gallons are there in 2 barrels?

6. How many gallons in 12 quarts? In 48? In 60?

7. In 3 hogsheads, how many barrels? In 5? In 9?

8. How many gallons are there in 3 hogsheads?

9. In 4 tuns, how many pipes? How many hogsheads?

10. What part of 1 quart is 1 pint? 2 pints are what part of 8 quarts? 3 pints of 5 quarts?

11. What part of a gallon is 1 pint? 3 pints? 5 pints? What part of a gallon is 1 gill?

12. What part of a barrel is 1 gallon? What part is 2 gallons? 5 gallons?

13. What part of a hogshead is 2 gallons? What part of a hogshead is 3 quarts? 9 quarts?

14. What part of a gallon is 3 gills? What part is 1½ pints? What part is 2½ pints?

15. What is the result of a gallon measuring a barrel? What is the ratio of a gallon to a barrel?

16. What is the ratio of a hogshead to a quart? Of a hogshead to 5 gallons?

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DRY MEASURE.

2 Pints (*pt.*) ......make	1 Quart............*qt.*
8 Quarts .... "	1 Peck ....*pk.*
4 Pecks .... "	1 Bushel..........*bu.*
36 Bushels .... "	1 Chaldron........*ch.*

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1. What are the units of Dry Measure? What are the scales in passing from each unit to the next greater?

2. How many pints in 2 quarts? In 6? In 8? In 12?

3. How many quarts in 6 pints? In 20 pints? In 15? In 3 pecks? In 4¼ pecks? In 6⅛?

4. What part of a peck is 7 quarts? What part of a peck is 1 pint? 5 pints?

5. What part of a bushel is 7 quarts? What part is 8 quarts? 18 quarts?

6. What part of a chaldron is 9 bushels? What part is 29 bushels? What part is 18 bushels?

7. What part of a chaldron is 5½ pecks? What part is 7 pecks? 9 pecks?

8. What is the ratio of 1 peck to a bushel? What is the ratio of 6 bushels to 3 pecks?

LESSON VI.

UNITS OF WEIGHT

There are three systems of weight in common use, viz.: Avoirdupois Weight, Troy Weight, and Apothecaries' Weight. Avoirdupois Weight is used in expressing the weight of all heavy goods. Troy Weight is used in weighing gold, silver, precious stones, and liquids. Apothecaries Weight is used by druggists and physicians in mixing medicines.

The ounce Avoirdupois, from which all the other weights are derived, is the one-thousandth part of the weight of a cubic foot of pure rain-water; hence, the unit of weight comes from the unit of volume.

AVOIRDUPOIS WEIGHT.

16 Drams (*dr.*).....make	1 Ounce............*oz.*
16 Ounces .... "	1 Pound............*lb.*
25 Pounds .... "	1 Quarter ....*qr.*
4 Quarters .... "	1 Hundredweight...*cwt.*
20 Hundredweight .. "	1 Ton ....*Ton.*

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1. What are the units of Avoirdupois Weight? What are the scales in passing from each unit to the next greater?

2. How many drams in 2 ounces? In 4? In $3\frac{1}{8}$?

3. How many ounces in 64 drams? In 80? In 144?

4. How many pounds in 96 *oz.*? In 128 *oz.*? In 64?

5. In 4 quarters, how many pounds? In $3\frac{2}{5}$ *qr.*? In 16 quarters, how many hundredweight? In 32 *qr.*?

6. How many pounds in 4 *cwt.* 3 *qr.* 2 *lb.*?

7. What part of a pound is 3 ounces? What is the standard? What is the ratio of 1 pound = 16 ounces, to 3 ounces?

8. What is the ratio of 3 ounces to 1 pound? How much is the measure of 1 pound, by 3 ounces as a standard?

9 What part of a ton is 3 quarters of a hundred-weight? What part of a ton is 5 pounds?

10. What part of 5 pounds is 8 ounces? What part is 4 ounces? 12 ounces = $\frac{3}{4}$ of a pound?

11. What is the ratio of 1 pound to 1 quarter? What of 1 quarter to 1 pound?

12. What is the ratio of 5 hundreds to 1 ton? Of 5 tons to 3 quarters? Of 1 ton to 1 pound?

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TROY WEIGHT.

24 Grains (gr.) .....make	1 Pennyweight....*pwt.*
20 Pennyweights ... "	1 Ounce ....*oz.*
12 Ounces .... "	1 Pound ....*lb.*

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1. What are the units of Troy Weight? What are the scales in passing from each unit to the next greater?

2. How many grains are there in 2 pennyweights? In 4 *pwt.*? In 6 *pwt.*? In $\frac{1}{2}$ *pwt.*? In $\frac{1}{6}$ *pwt.*?

3. How many pennyweights are there in 24 grains? In 72 grains? In 48 *gr.*? In 96 *gr.*? In 2 ounces?

4. How many ounces in 40 *pwt.*? In 100 *pwt.*?

5. In 2 pounds, how many ounces? In 4 *lb.*? In 3?

6. In 60 ounces, how many pounds? In 24 ounces, how many half-pounds? In 96 *oz.*, how many pounds?

7. What part of 3 pennyweights is 5 grains? What

is the ratio of 1 pennyweight to 1 ounce = 20 penny-weights ?

8. What part of 5 pounds is 5 ounces ?   What part of 4 pounds is 9 ounces ?

9. What part of 6 ounces is 3 pennyweights ?   What part of 8 pennyweights is 1 grain ?

APOTHECARIES' WEIGHT.

20 Grains (gr.) ....make	1 Scruple.........℈
3 Scruples .... "	1 Dram ....℥
8 Drams............. "	1 Ounce ....℥
12 Ounces .... "	1 Pound ....℔

1. What are the units of Apothecaries' Weight ? What are the scales ?

2. How many grains in 2 scruples ?   In 5 scruples ?

3. How many scruples in 40 grains ?   In 80 ?   In 60 ?

4. How many ounces are there in 5 ℔ 8 ℥ ?   In 8 ℔ 10 ℥ ?   In 32 drams ?   In 72 drams ?

5. What part of an ounce is 1 dram ?   What part of an ounce is $2\frac{1}{2}$ drams ?

6. What is the ratio of 1 pound to 7 drams ?   Of 1 dram to 1 pound ?

7. What part of 5 pounds is 7 ounces ?   What is the ratio of 7 ounces to 5 pounds ?

LESSON VII

UNITS OF TIME.

The length of the day, is the time required by the earth to revolve once on its axis ; and the length of the

year, is the time required to revolve once around the sun.
The day, is the leading unit of this measure.

TIME MEASURE.

60	Seconds (*sec.*) .... make	1 Minute ...... *min.*
60	Minutes .... "	1 Hour.... ....*hr.*
24	Hours........... "	1 Day..........*da.*
7	Days............ "	1 Week ....*wk.*
52¼	Weeks, or ⎫	
365	Days, or ⎬ "	1 Common Year.*yr.*
12	Calendar Months ⎭	
366	Days............ "	1 Leap Year ....*yr.*
100	Years........... "	1 Century ......*C.*

The year is divided into 12 calendar months. These
months have not all the same number of days. They are
as follows:

Winter.	⎰ 1st month,	January	....has	31	days.
	⎱ 2d "	February	... "	28 or 29	days.
Spring .	⎧ 3d "	March	...... "	31	days.
	⎨ 4th "	April	.... "	30	days.
	⎩ 5th "	May	.... "	31	days.
Summer	⎧ 6th "	June	.... "	30	days.
	⎨ 7th "	July	.... "	31	days.
	⎩ 8th "	August	..... "	31	days.
Autumn	⎧ 9th "	September	.. "	30	days.
	⎨ 10th "	October	.... "	31	days.
	⎩ 11th "	November	.. "	30	days.
Winter...	12th "	December	.. "	31	days.

365 *da.* in a year.

Thirty days hath September,
April, June, and November;
All the rest have thirty-one,
Excepting February, twenty-eight alone.

1. What are the units of Time Measure? What are its scales? How much longer is a leap year than a common year? How often has February 29 days?

2. In 2 minutes, how many seconds? In 5 *min.*? In $3\frac{1}{2}$ *min.*? In $3\frac{1}{6}$ *min.*? In $\frac{2}{3}$ *min.*?

3. How many minutes are there in 120 seconds? In 240 seconds? In 3 hours? In $6\frac{1}{2}$ hours?

4. How many hours in 300 minutes? In 480 *min.*? How many half-hours in 150 minutes? In 120 *min.*?

5. How many hours are there in 3 *da.* 12 *hr.*? In 5 *da.* 14 *hr.*? In $5\frac{1}{12}$ days? In $7\frac{1}{6}$ days?

6. How many days are there in 7 weeks? In 5 *wk.*?

7. What is the value of a common year measured by 1 day? What is the ratio of 1 day to a year?

8. What part is 1 week of a common year? What part is 7 days of a leap year? What part is 1 day of 1 week?

9. What part is 3 minutes of 2 hours? What is the ratio of 1 hour to 1 minute?

10. What part of a day is one-third of an hour?

11. What is the ratio of 1 hour to 1 day? Of 1 day to 1 hour? What part of a week is 1 hour?

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LESSON VIII.

CIRCULAR MEASURE.

The leading unit of this measure is the degree.

60 Seconds (″)....make	1 Minute	′.
60 Minutes .... "	1 Degree ....○.	
15○ .... "	1 Hour Angle ......*h. a.*	
30 Degrees .... "	1 Sign ....*s.*	
12 Signs, or 360○.. "	1 Circumference....*c.*	

1. What are the units of Circular Measure? What are the scales in passing from each unit to the next greater?

2. How many seconds in 3 minutes? In 5'? In 7'?

3. How many minutes in 6 degrees? In 4°? In 9°? In $\frac{1}{2}$ of a degree? In $\frac{1}{3}$°? In $\frac{3}{4}$°? In $\frac{5}{6}$°?

4. In 240 minutes, how many degrees? In 720'?

5. How many degrees in 4 signs? In 6? In $2\frac{1}{2}$?

6. In 90°, how many signs? In 150°? In 360°?

7. What is the value of 1 degree measured by 1 minute? What is the ratio of 1 minute to 1 degree? What is the ratio of 1 degree to 1 minute?

8. What part of 1 degree is 1 minute? What part is 9 seconds of 25 minutes? What part of 2 degrees is 45 minutes?

9. What part is the hour angle, 15°, of 360°? What part of 24 hours is 1 hour?

10. What is the ratio of the hour angle to 360°? What is the ratio of 1 hour to 1 day?

MISCELLANEOUS TABLE.

12 units.........make	1 dozen ....*doz.*
12 dozen .... "	1 gross ....*gross.*
12 gross......... "	1 great gross .....*g. gross*
20 units......... "	1 score.

24 sheets of paper...............make	1 quire.
20 quires .... "	1 ream.

100 pounds..............make	1 quintal of Fish.
196 pounds............. "	1 barrel of Flour.
200 pounds............. "	1 barrel of Pork.

LESSON IX.

PERCENTAGE.

Per cent , means, by the hundred.

One per cent. of a number, is one-hundredth part of the number ; 2 per cent., is 2 hundredths ; 3 per cent., is 3 hundredths ; 4 per cent., is 4 hundredths, &c.

The *rate,* or *rate per cent.,* is the number denoting how many hundredths are taken.

1. What part of a number is 5 per cent. of the number ?

ANALYSIS.—*Five per cent. of a number, is* $\frac{5}{100}$ *of it :* $\frac{5}{100} = \frac{1}{20}$ *: Therefore, 5 per cent. of a number, is* $\frac{1}{20}$ *of it.*

NOTE.—The fraction expressing the per cent., reduced to its lowest terms, is the required number.

2. What part of a number is 6 per cent. of the number ?

3. Forty per cent. of a number, is what part of the number ?

4. Ten per cent. of a number, is what part of the number ?

5. $12\frac{1}{2}$ per cent. of a number, is what part of the number ?

6. 15 per cent. of a number, is what part of the number ?

7. 25 per cent. of a number, is what part of the number ?

8. $33\frac{1}{3}$ per cent. of a number, is what part of the number ?

9. 75 per cent. of a number, is what part of the number ?

10. $66\frac{2}{3}$ per cent. of a number, is what part of it ?

11. Eighty per cent. of a number, is what part of it?

12. 50 per cent. of a number, is what part of it?

13. $\frac{2}{5}$ per cent. of a number, is what part of the number?

ANALYSIS.—$\frac{2}{5}$ per cent., is $\frac{2}{5}$ of 1 per cent.: 1 per cent. of a number, is $\frac{1}{100}$ of the number: Therefore, $\frac{2}{5}$ per cent. of a number, is $\frac{2}{5}$ of $\frac{1}{100} = \frac{2}{500} = \frac{1}{250}$ of the number.

14. $\frac{4}{9}$ per cent. of a number, is what part of the number?

15. $\frac{5}{12}$ per cent. of a number, is what part of the number?

16   100 per cent. of a number, is how many times the number?

17   200 per cent. of a number, is how many times the number?

18.   150 per cent. of a number, is how many times the number?

19.   212 per cent. of a number, is how many times the number?

20.   365 per cent. of a number, is how many times the number?

21.   400 per cent. of a number, is how many times the number?

22. $\frac{1}{8}$ of a number, is what per cent. of that number?

ANALYSIS.—*If the numerator and denominator be each multiplied by such a number as shall reduce the denominator to* 100, *the numerator will express the per cent.: Therefore,* $\frac{1}{8}$ *of a number is* $12\frac{1}{2}$ *per cent. of it*

NOTE.—The number by which to multiply the numerator and denominator, is the quotient which arises by dividing 100 by the denominator.

23. What per cent. is $\frac{1}{5}$ of a number? $\frac{1}{6}$ of it?

24. $\frac{1}{9}$ of a number, is what per cent. of the number?

25. What per cent. is $\frac{2}{7}$ of a number? $\frac{3}{4}$ of it?

26 What per cent. is $\frac{5}{8}$ of a number? $\frac{9}{10}$ of it?

27. What per cent. is $\frac{7}{12}$ of a number? $\frac{5}{16}$ of it?

28.   5 is what per cent. of 20?

ANALYSIS.—5 *is* $\frac{1}{4}$ *of* 20: $\frac{1}{4}$ *of a number is* 25 *per cent. of it: Therefore,* 5 *is* 25 *per cent. of* 20.

29.   6 is what per cent. of 18?   Of 24?   Of 30?

30. 10 is what per cent. of 50?   Of 30?   Of 40?

31.   3 is what per cent. of 12?   Of 15?   Of 16?

32. Forty is what per cent. of 80?   Of 20?   Of 10?

33. $\frac{3}{4}$ is what per cent. of $2\frac{1}{2}$?   Of $3\frac{1}{5}$?   Of $\frac{5}{6}$?

34. $3\frac{1}{4}$ is what per cent. of $5\frac{1}{5}$?   Of $2\frac{5}{6}$?   Of 8?

35. $\frac{1}{2}$ of a dollar, is what per cent. of $\frac{7}{8}$ of a dollar?

36.   3 is what per cent. of 2?

ANALYSIS.—3 *is* $1\frac{1}{2}$ *times* 2: $1\frac{1}{2}$ *times a number, is* 150 *per cent. of that number: Therefore,* 3 *is* 150 *per cent. of* 2.

37. What per cent. is 4 of 2?   8 of 6?   4 of 1?

38. What per cent is 10 of 5?   6 of 2?   2 of 1?

LESSON X.

1. What is 4 per cent. of $50?

ANALYSIS.—*Four per cent. of* 50, *is* $\frac{4}{100}$ *of* 50: $\frac{4}{100}$ *of* 50 = $\frac{200}{100}$ = 2: *Therefore,* 4 *per cent. of* $50, *is* 2 *dollars.*

NOTE.—Two dollars is called, the *percentage* of $50. The operation of finding the percentage, is equivalent to multiplying one-hundredth of the number by the rate; or, to multiplying the number by the rate, and dividing the product by 100.

2. What is 6 per cent. of 200 dollars?

3. What is 4 per cent. of $150? Of $200?

4 What is 9 per cent. of $300? Of $250?

5. What is 8 per cent. of $70? Of $90?

6 What is 6 per cent. of $60? Of $50?

7 What is 7 per cent. of $40? Of $50? Of $75?

8. What is 5 per cent. of 7 barrels of flour?

9 What is 3 per cent. of 16 bushels of corn?

10. What is 25 per cent. of 12 tons of iron?

11. What part of 1 is 3 per cent. of 30? What part of 1 is 4 per cent. of 25?

12. What is $3\frac{1}{2}$ per cent. of $100? Of $40?

13. What is $2\frac{1}{2}$ per cent. of $200? $4\frac{1}{2}$ of $60?

14. What is $3\frac{3}{4}$ per cent. of $90? Of $50?

15. What is $\frac{1}{2}$ per cent. of 160? Of 275? Of 360?

16. What is $\frac{1}{4}$ per cent. of 250? Of 960? Of 1000?

17. What is $\frac{7}{8}$ per cent. of 240? Of 80? Of 320?

18. What is $\frac{5}{6}$ per cent. of $2? Of $7\frac{1}{4}$? Of $1?

19. 16 is 8 per cent. of what number?

ANALYSIS.—8 *per cent. of a number, is* $\frac{8}{100}$ *of that number: if 16 is* $\frac{8}{100}$ *of a number, 1 hundredth of that number is 2, and the number itself, 200: There-fore, 16 is 8 per cent. of 200.*

20. 20 is 4 per cent. of what number?

21. 75 is 5 per cent. of what number?

22 27 is 9 per cent. of what number?

23 18 is 6 per cent. of what? 12 per cent. of what?

24. 24 is 3 per cent. of what? 16 per cent. of what?

25. 50 is 25 per cent. of what? $\frac{2}{5}$ per cent. of what?

26. $\frac{3}{4}$ is 6 per cent. of what? 18 per cent. of what?

27. $8\frac{1}{6}$ is 5 per cent. of what? 12 per cent. of what?

28. 25 is $4\frac{1}{6}$ per cent. of what? $3\frac{1}{8}$ per cent. of what?

LESSON XI.

PROMISCUOUS EXAMPLES.

1. If a horse costs $125, and is sold at a profit of 25 per cent., what is the gain?

Note.—The gain or loss is always reckoned on the cost.

2. A carriage cost $350, and was sold at a profit of $12\frac{1}{2}$ per cent.: what was the profit?

3. A coat was marked $15, but the clothier took off 8 per cent.: what was the amount of the deduction?

4. A merchant bought 300 pineapples, but, on examination, found 15 per cent. of them spoiled: how many were lost?

5. A grocer purchased a bag of coffee, at 10 cents a pound: at what price must he sell it a pound, in order to gain 10 per cent.? What must he sell it at, to gain 25 per cent.?

6. If a piece of broadcloth, containing 30 yards, cost $5 a yard, for what must it be sold, to gain 20 per cent.?

7. A merchant finds that a lot of goods, which cost $60, is damaged; he sells them at a loss of 15 per cent.: what does he get for them?

8. The price of a book is 80 cents; but, being sold to a friend, a discount is made of 20 per cent.: what is paid for it?

9. A grocer bought 10 barrels of flour, at $8 a barrel: what must they be sold for, to gain 25 per cent.?

10. A piece of cloth, which cost $45, is somewhat damaged, and is sold at a discount of $33\frac{1}{3}$ per cent.: what is received for it?

11. If a grocer buys sugar at 6 cents a pound, and sells it at 8, what per cent. does he make?

12. A grocer buys sugar at 6 cents a pound, and sells it at 9 : how much per cent. does he make ?

13. A bag of coffee was bought at 10 cents a pound, and being injured, it was sold at 8 cents a pound : what per cent. was lost ?

14. A horse, that cost $150, was sold for $125 : what per cent. was lost ?

15. An agent collected $200, and was allowed 4 per cent. : what did he receive for collecting, and what did he pay over ?

16. A commission merchant sold goods to the amount of $500, charging $3\frac{1}{2}$ per cent. : what was his commission ?

17. An insurance company insured a house for $1200, and charged $1\frac{1}{2}$ per cent. : what was the insurance ?

18. If the charge for insurance is $\frac{3}{4}$ per cent., what must be paid for insuring goods to the amount of $1000 ?

19. What is the tax on a house, that is assessed at $3500, at 2 per cent. ?

20. A book was sold for $8, by which 20 per cent. was lost : what did the book cost ?

ANALYSIS.—*Since 20 per cent. was lost by the sale,* $8 *is* 100 − 20 = 80 *per cent. of the cost :* 80 *per cent. of a number, is* $\frac{4}{5}$ *of it : Therefore,* $8 *is* $\frac{4}{5}$ *of the cost, or the cost is* $10.

21. A book was sold for $6, and thereby a gain of 30 per cent. was made : what was the cost of the book ?

ANALYSIS.—*Since 30 per cent. was gained by the sale,* $6 *is* 100 + 30 = 130 *per cent. of the cost :* 130 *per cent. of a number, is* $1\frac{3}{10}$ *of it : Therefore,* $6 *is* $1\frac{3}{10}$ *of the cost, or the cost is* $4\frac{8}{13}$.

22. A barrel of flour was sold for $9, by which a gain of 20 per cent. was made : what was the cost of the flour ?

23. Tea is selling at 80 cents a pound, which is an advance of 4 per cent. on former prices: what was the former price?

24. A merchant, in need of money, sold goods for cash to the amount of $3000, and thereby lost 10 per cent. what was the cost of the goods?

25. Five shares of stock were sold for $480, which was 4 per cent. discount: what was their par value?

26. How much merchandise must a commission merchant sell, at a commission of 5 per cent., to gain $60?

27. The attendance at a certain school has diminished by 40, which is 10 per cent. of the number on the roll: what was the number on the roll?

28. In a company, 14 men were killed, which was 20 per cent. of the company: what was the number in the company?

29. In a spelling lesson, 24 words were misspelled, and these were 16 per cent. of the words in the lesson: how many words in the lesson?

30. A gentleman paid $25 for insurance, at 2 per cent.: for what amount was he insured?

31. A horse and harness together cost $350; the harness cost 25 per cent. of the value of the horse: what was the value of the horse and harness?

32. A book that cost 2 dollars, was sold for 3 dollars, and a portfolio that cost 75 cents, was sold for 90 cents: what was the per cent. of gain on each?

33. A merchant sold one lot of flour for $190, and lost 5 per cent.; he sold another lot for $318, and gained 6 per cent.: what was the total gain, or loss?

34. A person bought a quantity of oranges; on examination, $\frac{1}{8}$ of them was found unfit for sale: what per cent. was good?

LESSON XII

INTEREST.

Interest is an allowance made for the use of money It is reckoned by the year, and at a given per cent.

Principal is the money on which interest is reckoned.

Amount is the sum of the interest and principal.

Rate is the given per cent. of interest?

Time is generally reckoned in years, and the fractions of a year. The year, in computing interest, is reckoned at 360 days, and the month, at 30 days.

1. What is the annual interest of $250, at 6 per cent.?

ANALYSIS.—*The annual interest of* $250, *at* 6 *per cent., is* $\frac{6}{100}$ *of the principal:* $\frac{1}{100}$ *of the principal, is* $2.50, *and* 6 *times that, is* $15: *Therefore, the annual interest of* $250, *is* $15.

2. What is the interest of $300, for 1 year, at 6 per cent.?

3. What is the yearly interest of $600, at 7 per cent.?

4. What is the annual interest of $250, at 8 per cent.?

5. What is the annual interest of $350, at 9 per cent.?

6. What is the annual interest of $650, at $7\frac{1}{2}$ per cent.?

7. What is the yearly interest of $560, at $8\frac{1}{4}$ per cent.?

8 What is the annual interest of $620, at $3\frac{1}{2}$ per cent.?

9. What is the annual interest of $1000, at 9 per cent.?

10. What is the interest of $360, for 3 years, at 5 per cent.?

ANALYSIS.—*The interest for* 3 *years, is* 3 *times as much as for* 1 *year: the interest for* 1 *year, is* $\frac{5}{100}$ *of the principal: Therefore, the interest for* 3 *years, is* $\frac{15}{100} = \frac{3}{20}$ *of the principal, which is* $54.

11. What is the annual interest of $9, at 2 per cent. ?

12. What is the interest of $160, for 3 years, at 5 per cent. ?

13. What is the interest of $200, for 2 years, at 5 per cent. ?

14. What is the interest of $300, for 2 years, at 4 per cent. ?

15. What is the interest of $500, for 3 years, at 6 per cent. ?

16. What is the interest of $90, for 3. years, at 2 per cent. ?

17. What is the interest of $125, for 2 years, at 7 per cent. ?

18. What is the interest of $375, for 2 years, at 5 per cent. ?

19. What is the interest of $500, for 3 years, at $3\frac{1}{4}$ per cent. ?

20. What is the interest of $7, for 5 years, at $2\frac{1}{2}$ per cent. ?

21. What is the amount of $120, for 3 years, at 3 per cent. ?

ANALYSIS.—*The amount is the principal plus the interest : the principal is* $120, *and the interest is* $10.80 : *Therefore, the amount is* $130.80.

22. What will be the amount of $60, for 3 years, at 6 per cent. ?

23. If $80 be put at interest for 2 years, at 4 per cent., what will be the amount ?

24. What will be the amount, if $250 be put at interest, at 6 per cent., for 3 years ?

25. What will be the amount of $500, for 7 years, at 4 per cent. ?

26. What will be the amount, if $55 be put at interest for 5 years, at 7 per cent.?

27 What will be the amount of $75, when put out at interest for 12½ years, at 8 per cent.?

28. What will be the amount of $175, after drawing interest for 3 years, at 5 per cent.?

29. What will be the amount of $86, for 3 years, at 3 per cent.?

30. What is the amount of $240, for 10 years, at 10 per cent.?

31. What is the amount of $150, for 100 years, at 6 per cent.?

LESSON XIII.

1. What is the interest of $120, for 5 months, at 8 per cent.?

ANALYSIS.—*The interest for 5 months, is $\frac{5}{12}$ of the interest for 1 year: the interest for 1 year, is $9.60: Therefore, the interest for 5 months, is $\frac{5}{12}$ of $9.60, or $4.*

2. What is the interest of $300, at 6 per cent., for 9 months?

3. What is the interest of $350, at 4 per cent., for 11 months?

4. What is the interest of $600, at 5 per cent., for 10 months?

5. What is the interest of $200, for 2 years and 6 months, at 6 per cent.?

ANALYSIS.—*The interest for 2 years, is twice the interest for 1 year, or 12 per cent.: the interest for 6*

months, is $\frac{6}{12} = \frac{1}{2}$ *the interest for* 1 *year, or* 3 *per cent.: Therefore, the interest of* \$200, *for* 2 *years and* 6 *months, at* 6 *per cent., is* 15 *per cent. of the principal, or, the interest is* \$30.

Note.—When there are years and months, find what per cent. the interest is of the principal. Then find the interest.

6. What is the interest of \$200, for 3 months, at 1 per cent. ?

7. What is the interest of \$60, for 4 months, at 3 per cent. ?

8. What is the amount of \$40, for two years and 6 months, at 6 per cent. ?

9. What is the amount of \$90, for 1 year and 9 months, at 8 per cent. ?

10. What is the interest of \$15, for 10 months, at 12 per cent. ?

11. What is the interest of \$6, for 2 years 8 months, at 6 per cent. ?

12. What is the interest of \$12, for 1 year 11 months, at 8 per cent. ?

13. What is the interest of \$25, for 2 years 8 months, at 9 per cent. ?

14. What is the interest of \$1, for 1 mo. at 7 per cent. ?

15. What is the interest of \$60, for 3 years 8 months, at 6 per cent. ?

16. What is the interest of \$30, for 2 years, 9 months, and 18 days, at 8 per cent. ?

Analysis.—*The per cent. for* 2 *years, is* 16; *for* 9 *months,* $\frac{3}{4}$ *of* 8 = 6; *for* 18 *days* = $\frac{18}{30}$ = $\frac{3}{5}$ *of* 1 *month, it will be* $\frac{3}{5}$ *of what it is for* 1 *month, or* $\frac{3}{5}$ *of* $\frac{8}{12}$ = $\frac{2}{5}$: *hence, the per cent. of interest will be,* $22\frac{2}{5}$; *and the interest will be that per cent. of* \$30, *which is* \$6.72.

17. What is the interest of $84, for 10 days, at 7 per cent. ?

18. What is the interest of $24, for 15 days, at 8 per cent. ?

19. What is the interest of $96, for 20 days, at 7 per cent. ?

20. What is the interest of $144, for 12 days, at 5 per cent. ?

21. What is the interest of $72, for 5 months and 10 days, at 8 per cent. ?

22. What is the interest of $36, for 1 month 24 days, at 5 per cent. ?

23. What is the interest of $15, placed at interest for 2 years 6 days, at 8 per cent. ?

24. What is the amount of $75, after having been on interest for 3 years 6 months 12 days, at 2 per cent. ?

25. What is the interest of $1, for 1 year 1 month 1 day, at 1 per cent. ?   At 10 per cent. ?

26. A person owes a merchant $600 for a bill of goods ; it has been due 6 months 24 days : supposing interest to be 7 per cent., what amount is due ?

27. A note of $250 remained unpaid 9 months 20 days after it was due : what amount ought to be paid at the end of the time, the rate of interest being 6 per cent. ?

28. A bill of goods, amounting to $500, is overdue 3 months 27 days : what interest is due, if the rate is 6 per cent. ?

LESSON XIV.

1. When interest is at the rate of 7 per cent., and the time is 2 years, what part of the principal equals the interest ?

ANALYSIS.—*For one year, the interest is $\frac{7}{100}$ of the principal, and for 2 years, it will be 2 times $\frac{7}{100} = \frac{14}{100} = \frac{7}{50}$ of the principal: hence, $\frac{7}{50}$ of the principal equals the interest.*

2. At 8 per cent., for 3 years, what part of $6 will equal the interest of $6?

3. At 6 per cent., for 2 years 6 months, what part of $130 will equal the interest?

4. The interest of $175 will be what part of the same, when the rate is 9 per cent., and the time 3 years 8 months 12 days?

5. When the rate is $4\frac{1}{4}$ per cent., and the time 3 months 6 days, what part of the principal equals the interest?

6. What part of $251 will equal the interest of the same, at $2\frac{1}{3}$ per cent., and for 1 year 6 months 15 days?

NOTE.—The *part* which the interest is of the principal, does not depend on the amount at interest; hence, it is always best to find the part on $1.

7. In what time will any sum of money double itself, when the rate is 6 per cent.?

ANALYSIS.—*A sum of money doubles itself, when the interest becomes equal to the principal. A sum of money will double itself in as many years, as the interest of $1 for 1 year, is contained times in $1. The interest of $1, for a year, is $\frac{6}{100} = \frac{3}{50}$ of principal: $\frac{3}{50}$ is contained in 1, $\frac{50}{3}$ times $= 16\frac{2}{3}$ times. Therefore, any sum, at 6 per cent., will double itself in $16\frac{2}{3}$ years.*

8. In what time will $75 double itself, at 8 per cent.?

9. At 14 per cent., in what time will $20 double itself?

10. At 10 per cent., in what time will $50 double itself?

11. In what time will a sum of money double itself, at 3 per cent. ?

12. At 2 per cent., in what time will a sum of money double itself?

13 In what time, at 7 per cent., would $80 amount to $160 ?

14. In what time, at 12½ per cent., will $600 amount to $1200 ?

15. At what rate will a sum of money double itself, in 5 years ?

ANALYSIS.—*At* 100 *per cent., a sum of money will double itself in one year : The rate, necessary to produce in 5 years the same interest that* 100 *per cent. will produce in one year, must be* ⅕ *of* 100 *per cent., which is* 20 *per cent.: Therefore, a sum of money, in 5 years, will double itself at* 20 *per cent.*

16. At what rate will a sum of money double itself in 2 years ? In 4 years?

17. At what rate will a sum of money double itself in 1 year ? In 1 year 9 months ?

18. At what rate will $60 give $60 of interest in 3 years ? In 4⅘ years ?

19. At what rate will a sum of money double itself in 16 years?

20. At what rate will a sum of money double itself in 14 years?

21. In what time will $600 amount to $726, at 6 per cent. ?

22. At what rate will $360 amount to $427½ in 3 years 9 months ?

23. In what time will $550 amount to $704, at 7 per cent. ?

SECTION SEVENTH.

LESSON I.

1. A person bought an equal number of oranges and lemons, for 80 cents; for the oranges he paid 3 cents each, and for the lemons, 2 cents: how many of each did he buy?

ANALYSIS.—*Since 1 of each cost 5 cents, he must have bought as many of each, as 5 is contained times in 80: 5 is contained in 80, 16 times: Therefore, he bought 16 of each.*

2. John and James worked an equal number of weeks, for $96; John at $3, and James at $5 a week: how many weeks did each work?

3. A boy spent 60 cents in buying an equal number of 2 kinds of tops; for one kind he paid 4 cents apiece, and for the other, 6 cents: how many of each kind did he buy?

4. A farmer bought an equal number of pigs, sheep, and cows, for $90; he paid $2 apiece for the pigs, $3 apiece for the sheep, and $25 for the cows: how many of each did he buy?

5. A lady wishes to buy an equal number of yards of cloth and silk, for $33; she paid $1¼ a yard for the silk, and $1½ for the cloth: how many yards of each did she buy?

6. A tailor had a piece of cloth, containing 51 yards, and cut it so as to have an equal number of coats and pantaloons; the coats required 6 yards, and the pants 2½ yards: how many of each did he cut out?

7 A person has 10 gallons of wine, to be put into an equal number of 2 kinds of bottles; the first kind holds 1 pint, and the second, $1\frac{1}{2}$ pints: how many of each did he take?

8. A farmer bought some cows and sheep, for $180; he bought 3 times as many sheep as cows; for the cows he paid $24 apiece, and for the sheep, $2: how many of each did he buy?

9. James and John, together, have 36 marbles; James has 6 more than John: how many has each?

ANALYSIS.—*Since James has 6 marbles more than John, if this number be taken from James' marbles, there will be 30 left, and each will have an equal share: Therefore, John's marbles are equal to $\frac{1}{2}$ of 30, which is 15, and James' to* 15 + 6 = 21.

10. William and Robert have 16 marbles; William has 4 more than Robert: how many has each?

11. Nancy has 6 more pins in the cushion than Jane, and they together have 30: how many has each?

12. John, in a week, recited 10 lessons more than Charles, and together they recited 24: how many did each recite?

13. Lucy being asked her age, said, that her sister Jane was 6 years old, when she was born, and that now the sum of their ages was 20: what was the age of each?

14. A man bought a vest, for which he paid $21 less than he paid for his coat, and for the two together he paid $33: what did he pay for each?

15. Two men have $60 between them; if the one having the larger sum gives the other $5, their money will be equal: how much had each?

16. A tailor, in measuring two pieces of cloth, found

their difference to be 6 yards, and also, that this difference was an eighth part of the cloth in both pieces: how much was there in each piece?

17. A man being asked how much money he had, said, that he had only dollars and dimes, and that he had 72 pieces in all; and that the number of dollars less the number of dimes, was $\frac{1}{12}$ of all the pieces: how many of each had he?

18. A farmer bought an equal quantity of sugar and coffee, and then gave a cheese for 20 pounds more of coffee, when it appeared that he had in all 50 pounds of coffee and sugar: how much of each had he?

19. A farmer has 10 more sheep than cows; he loses 3 cows and 6 sheep, when he finds that he has 17 of both kinds remaining: how many had he at first of each?

20. A father and son engaged to work 20 days, the son to receive 3 dimes a day less than the father; at the end of the time, they received $42: what did each receive a day, and how much of this sum did each earn?

21. The sum of two numbers is 10, and their difference, 4: what are the numbers?

22. The sum of two numbers is 16, and their difference, 8: what are the numbers?

23. Two boys earned, between them, $1\frac{5}{8}$; one was entitled to have $\frac{1}{2}$ of a dollar more than the other: how much was each to have?

24. Two men spent, together, $4\frac{1}{5}$; the one spent $\frac{3}{4}$ of a dollar more than the other: how much did each spend?

25. A person meeting some beggars, gave them 5 cents each, and had 8 cents left; had he given them 7 cents each, he would have needed 10 cents more than he had: how many beggars were there?

ANALYSIS.—*In order to give each beggar 7 cents, he required* 18 *cents more than when he gave each 5 cents. The difference of 7 and 5, which is 2, taken as many times as there were beggars, must give* 18; *hence, there were as many beggars as 2 is contained times in 18, which is 9: Therefore, there were 9 beggars.*

26. A servant was directed to purchase the best muslin she could, for a certain sum. If she bought one kind, at 10 cents a yard, she would have 6 cents left; if she bought another kind, at 12 cents a yard, she would need 10 cents more: how many yards could she buy?

27. A farmer wished to expend a sum of money in the purchase of sheep. There were two classes: in one, the sheep were $3 apiece, and in the other, $4½; if he bought of the first kind, he would have $2 over, and if of the second, he would lack $2½: how many sheep could he buy, and how much money had he?

28. A boy was directed, with a certain sum, to buy a given number of pounds of butter; if he bought at 20 cents a pound, he would have 12 cents over; if he bought at 24 cents, he would lack 16 cents: how many pounds could he buy?

29. If flour is bought at $5 a barrel, $4 will remain on hand; if it is bought at $6¼, there will be lacking $2¼: how many barrels could be bought?

30. If a certain number of oranges be bought at 4 cents each, 64 cents will be left; if the same number of cocoa-nuts, at 10 cents, be bought, 10 cents will be left: how many could be bought?

31. By selling a certain number of yards of calico at 15 cents a yard, a merchant gained 90 cents more than he would have gained, had he sold another kind at 12 cents: how many yards did he sell?

LESSON II.

Note.— This class of questions may be solved by the Analysis in Lesson V., page 50.

1. If 5 yards of cloth cost \$10, what will 8 yards cost, at the same rate?

Analysis.—*Eight yards are* $\frac{8}{5}$ *times as much as 5 yards; hence,* 8 *yards will cost* $\frac{8}{5}$ *times as much as 5 yards: 5 yards cost* \$10: *Therefore,* 8 *yards will cost* $\frac{8}{5}$ *times* \$10, *which is* \$16.

2. If 4 yards of cloth cost \$9, what will 16 yards cost, at the same rate?

3. If 6 men consume a barrel of flour in 2 months, how much will they consume in a year?

4. If $\frac{3}{4}$ of a piece of cloth costs \$8$\frac{1}{4}$, what will $\frac{9}{4}$ pieces cost?

5. If $\frac{4}{7}$ of a barrel of cider costs $\frac{9}{11}$ of a dollar, what will $\frac{2}{7}$ of a barrel cost?

6. If 8 oranges are worth 24 cents, how much are 2 oranges worth?

7. If 3$\frac{1}{2}$ yards of cloth cost \$6$\frac{2}{5}$, what will 14 yards cost?

8. If a family consumes 2$\frac{2}{5}$ bushels of grain in 3$\frac{1}{4}$ weeks, how much will they consume in 6$\frac{1}{2}$ weeks?

9. If 4 apples are worth 1$\frac{1}{2}$ oranges, and one orange is worth two lemons, how many lemons will 12 apples buy?

10. If 2 tons of hay cost \$19$\frac{1}{2}$, what will 8 *cwt.* cost?

11. If $\frac{4}{5}$ of a barrel of flour costs 5$\frac{1}{4}$ dollars, what will be the cost of $\frac{5}{8}$ of a barrel?

12 If the interest on \$6, for a certain time, and at a given rate, is 24 cents, what will be the interest of **\$10**, for the same time and rate?

13. If, out of every $5 earned, a mechanic saves $1½, how much will he save out of $72 ?

14. If a staff, 3 feet high, casts a shadow 6 feet in length, how long is a pole which casts a shadow 20 feet long, at the same time of day ?

15. If a staff, of 10 feet in length, casts a shadow of 15 feet, what length of shadow will a pole cast, that is 24 feet long ?

16. If a shadow, 10 feet long, is cast by a stick 5 *ft.* 6 *in.* high, what will be the length of a stick, standing in a like position, which casts a shadow 16 *ft.* 9 *in.* in length, at the same time of day ?

17. If 4 horses, in 2 days, eat 5 bushels of oats, how much will 6 horses eat in 4 days ?

ANALYSIS.—4 *horses, in 2 days, will eat as much as 1 horse in 8 days ; and 6 horses, in 4 days, will eat as much as 1 horse in 24 days. 1 horse, in 8 days, will eat one-third as much as 1 horse in 24 : 1 horse, in 8 days, eats 5 bushels : Therefore, 1 horse in 24 days, or 6 horses in 4 days, will eat 3 times 5 bushels, or 15 bushels.*

18. If 6 men consume 24 *lb.* of beef in 5 days, how much will 9 men consume in 10 days ?

19. If 2 men, in 5 days, can build 160 feet of wall, how long will it take 4 men to build 192 feet of wall ?

20. If a certain amount will support 2 families, of 5 persons each, 3 weeks, what would be required to support 5 families, of 6 persons each, for the same time ?

21. If 2 men consume 2 *lb.* 4 *oz.* of flour in 1 day, how much will 8 men consume in 4 days ?

22. If 5 men can cut 30 cords of wood in 3 days, how much will 4 men cut in 8 days ?

23. If 3 men can mow 15 acres in $2\frac{1}{2}$ days, how long will it take 11 men to mow 44 acres?

24. If a farmer can plow 9 acres, in 4 days, with one team, how much can he plow with two teams, in $8\frac{1}{3}$ days?

25. If a pasture, of 8 acres, will feed 3 horses for 2 months, how many acres will feed 4 horses for 5 months?

26. If 6 horses eat $2\frac{1}{2}$ tons of hay in 2 weeks, how much will 16 horses eat in $1\frac{1}{2}$ weeks?

27. If a man travels 48 miles in 2 days, traveling 6 hours a day, how far will he travel in 3 days, traveling at the same rate, 5 hours a day?

28. If a barrel of flour will serve a family of 6 persons $3\frac{1}{2}$ weeks, how much will serve a family of 9 persons $4\frac{2}{3}$ weeks?

29. If $\frac{5}{6}$ of a bushel of oats will feed 2 horses $\frac{1}{2}$ of a day, how much will be required to feed 4 horses $4\frac{2}{3}$ days?

30. If 1 man can do a piece of work in a certain time, how much could 4 men do in the same time?

31. If 5 men, in 4 days, can do a certain piece of work, how long will it take 1 man to do it?

32. If 8 men can build a wall in 6 days, in how many days can 12 men build it?

33. If a barrel of flour lasts 15 men, 20 days, how long will it last 25 men?

34. If 2 men can build a wall in 4 days, how long will it take 5 men to build it?

35. If 5 men can do a certain work in 6 days, how long will it take 3 men to do 5 times the work?

36. If 9 men can do a piece of work in $4\frac{2}{3}$ days, how many men should be employed to do the same work in 7 days?

37. If 6 men can do a piece of work in 20 days, how many men could do it in 8 days?

LESSON III.

1. James bought an orange and a melon for 8 cents; he paid 3 times as much for the melon as for the orange: what did he pay for each?

ANALYSIS.—*If we suppose the cost to be divided into 4 equal parts, 1 of the parts will pay for the orange, and the other three for the melon: ¼ of 8, is 2: Therefore, the orange cost 2 cents, and the melon 6 cents.*

2. Charles bought a whistle and a top for 12 cents; he paid 5 times as much for the whistle as for the top: what did he pay for each?

3. What number, added to itself, will give a sum equal to 20?

4. What number, added to twice itself, will give a number equal to 15?

5. John bought an apple, a peach, and an orange, for which he paid 6 cents; he paid twice as much for the peach as for the apple, and as much for the orange as for the apple and peach together: what did he pay for each?

6. A man bought a horse, saddle, and bridle, for which he paid $90; he paid twice as much for the saddle as for the bridle, and four times as much for the horse as for the saddle and bridle together: what did he pay for each?

7. What number, added to 5 times itself, will give a number equal to 30?

8. A farmer has in his garden, apple, pear, and peach trees, in all, 72; he has twice as many pear as apple trees, and 3 times as many peach as pear trees: how many has he of each?

9. A farmer has 72 sheep, in 4 lots: in the second lot

he has twice as many as in the first; in the third lot, as many as in the second; and in the fourth, twice as many as in the third: how many has he in each?

10. Divide 12 into 2 such parts, that the second shall be double the first.

11. Divide 21 into 3 such parts, that the second shall be double the first, and the third double the second.

12. Divide 82 into four such parts, that the second shall be 4 times the first, the third 3 times the second, and the fourth 2 times the third.

13. A gentleman gave 36 cents to a father, mother, and boy; he gave the mother twice as much as the boy, and the father twice as much as the mother and boy together: how much did he give to each?

14. James asked John, how many marbles he had? John replied, "If you will give me twice as many as I now have, and William will give me 5 times as many as I should then have, I would have, in all, 36:" how many had he?

15. Mr. Parsons bought 4 pounds of coffee, a pound of tea, and a yard of cloth, and paid in all $13; he paid twice as much for the tea as for the coffee, and 5 times as much for the cloth as for the coffee: what did he pay for each?

16. James being asked what he had been about during the day, replied, that he had been ciphering 4 hours, and done 82 examples; that in the second hour he had done 4 times as many as in the first; in the third hour, 3 times as many as in the second; and in the fourth, 2 times as many as in the third: how many did he do in each hour?

17. A father distributed 60 cents to his 3 children, giving to the oldest 5 cents more than 4 times what he gave the youngest; and to the second, 6 cents more than

2 times what he gave the youngest: what did he give to each?

18. If some butter, tea, and coffee cost $2, and the butter cost 10 cents less than 3 times the cost of the tea, and the coffee 30 cents less than 2 times the cost of the tea, what was the cost of each?

19. The sum of the ages of James, Charles, and John, is 42 years; James' age is $\frac{1}{2}$ of Charles', and $\frac{1}{3}$ of John's: what is the age of each?

20. In a school of 3 departments, there are 150 pupils; in the first department there is $\frac{1}{3}$ as many as in the second, and in the second, $\frac{1}{2}$ as many as in the third: how many are there in each?

21. Divide 36 marbles between James and Robert, so as to give Robert 9 more than $\frac{1}{2}$ of James' share: how many must each have?

22. Two men have $100; one of them has $10 less than $\frac{1}{4}$ of the money of the other: how much has each?

23. There is a fish, weighing 72 pounds; his head weighs twice as much as his tail, and his body weighs as much as his head and tail together: what is the weight of each part?

24. A fish weighs 64 pounds; the head weighs 3 times as much as the tail, and the body weighs as much as the head and tail both: what is the weight of each part?

LESSON IV.

1. What number, added to $\frac{1}{4}$ of itself, will give 20?

ANALYSIS.—20 *is equal to the number plus $\frac{1}{4}$ of the number, or equal to $\frac{5}{4}$ of the number: 20 is $\frac{5}{4}$ of 16: Therefore, the number is 16.*

2. What number, added to $\frac{1}{2}$ of itself, will give 9 ?

3. James being asked his age, said, I am half the age of my father, and the sum of our ages is 60 years : what is the age of each ?

4. What number is that to which if its $\frac{1}{6}$ be added, the sum will be 35 ?

5. What number, added to $\frac{1}{2}$ of itself and to $\frac{1}{4}$ of itself, will give 28 ?

ANALYSIS.—$\frac{1}{2}$ *of a number and* $\frac{1}{4}$ *of a number, are* $\frac{3}{4}$ *of the number :* 28 *is equal to the number plus* $\frac{3}{4}$ *of the number, or equal to* $\frac{7}{4}$ *of the number :* 28 *is* $\frac{7}{4}$ *of* 16 : *Therefore,* 16 *is the number.*

6. A man being asked his age, replied, "If to my age you add $\frac{1}{3}$ of it, and then $\frac{1}{4}$ of it, the sum will be 57 :" how old was he ?

7. What number, added to $\frac{1}{2}$, to $\frac{1}{3}$, and to $\frac{1}{4}$ of itself, will give a sum equal to 50 ?

8. Divide 20 into 3 such parts, that the second shall be $\frac{1}{2}$ of the first, and the third, $\frac{1}{3}$ of the second.

9. A gentleman bought a coat and hat, for which he paid $27 ; the hat cost $\frac{1}{8}$ of the cost of the coat : what was the cost of each ?

10. A coat and vest cost $24 ; the vest cost $\frac{1}{7}$ as much as the coat : what was the cost of each ?

11. What number is that to which if $\frac{2}{5}$ of itself be added, the sum will be 32 ?

12. A cow and calf are worth $56 : the calf is worth $\frac{3}{11}$ of the cost of the cow : what is the value of each ?

13. Divide the number 52 into two such parts, that $\frac{5}{8}$ of the larger part shall be equal to the less part ?

14. A yard-stick is broken into 2 parts ; the shorter is $\frac{4}{5}$ the length of the longer : what is the length of each ?

15. Divide 27 into two such parts, that the second shall be $\frac{4}{5}$ of the first?

16. John and James, together, have 45 marbles; if John's are equal to $\frac{2}{3}$ of James', how many has each?

17. James asked Robert how many marbles he had, Robert replied: "If you will give me $\frac{1}{2}$ of the number I now have, and then $\frac{1}{3}$ of that number, and William will then give 10, I shall have 120:" how many had he?

18. A young chap asked an old gentleman his age, who replied, "When you were born, I was $\frac{6}{7}$ of my present age; one-third of your age plus $\frac{1}{4}$ of it, is equal to 7 years: can you tell how old I am?"

19. A church, including the steeple, is 188 feet high; if the height of the steeple above the building is equal to $\frac{1}{3}$ the height of the body of the building, what is the height of each?

20. A pole, 16 feet long, stands in the mud, water, and air; the part in the mud is $\frac{1}{3}$ of the part in the water, and the part in the air is equal to the sum of the other two: what is the length of each part?

21. A man, after counting his gains at play, found that he had increased his money by $\frac{1}{2}$ of $\frac{1}{3}$, and that he then had $42: how much had he at first?

22. The difference of two numbers is 6, and the less number is $\frac{2}{3}$ of the greater: what are the numbers?

23. What number is that which, being increased by the difference between $\frac{3}{4}$ and $\frac{3}{5}$ of itself, gives a sum equal to 46?

24. John being asked how many marbles he had, said, that $\frac{1}{2}$ of what he had, increased by $\frac{1}{3}$ and diminished by $\frac{1}{4}$, was equal to 14: how many had he?

25. A tailor cuts a piece of cloth, 21 yards long, into 3 pieces; the second contains $\frac{1}{3}$ of the first, minus 5

yards, and the third is equal to $\frac{1}{4}$ of the first, plus 5 yards: how many yards are there in each piece?

26. What number is that to which if $\frac{1}{2}$ of itself, and 4 be added, the sum will be equal to 22?

27. What number is that which, being added to $\frac{1}{3}$ of itself and to 3 times itself, will give a sum equal to 26?

28. A man, after spending a part of his money at a tavern, found that what he had left was $\frac{1}{5}$ of what he had spent; and remembering that he had 84 cents at first, I wish to know how much he had left?

29. What number is that to the $\frac{1}{4}$ of which if 10 be added, the sum will be equal to 20?

30. What number is that to which if its $\frac{1}{4}$ be added, and the sum diminished by 7, will leave 13 for a remainder?

31. A watch and seal are together worth $64; the cost of the seal is $6 less than $\frac{1}{4}$ of the cost of the watch: what is the value of each?

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LESSON V.

1. What number is that, whose half exceeds its third by 4?

ANALYSIS.—*The half of a number, minus the third of it, is equal to $\frac{1}{6}$ of the number, which is 4 : 4 is $\frac{1}{6}$ of 24 : Therefore, 24 is the number.*

2. What number is that, $\frac{2}{3}$ of which exceeds its $\frac{1}{2}$ by 12?

3. What number is that, whose $\frac{1}{6}$ exceeds its $\frac{1}{9}$ by 3?

4. $\frac{2}{3}$ of a number is greater than $\frac{5}{11}$ of it, by $3\frac{1}{2}$: what is the number?

5. A father had a sum of money in his hand, which he

would give to the one who would tell him how much it was. If he gave $\frac{7}{8}$ of it to James, he (James) would have $10 more than Robert would receive, if his father gave him $\frac{2}{3}$ of the sum: what was the sum?

6. James received $\frac{1}{4}$ of a sum of money, and Robert $\frac{1}{7}$ of the sum; if $9 were added to Robert's share, then they would have equal sums: what was the sum of money, and what did each receive?

7. What number is that which, being diminished by its $\frac{1}{2}$ and its $\frac{1}{3}$, the remainder will be equal to 4?

8. A father's height was marked on the wall; his oldest son's height was $\frac{7}{9}$ of the father's, and the youngest son's was $\frac{2}{5}$ of the father's; the difference was $25\frac{1}{2}$ inches: what was the height of the father?

9. $\frac{1}{4}$ of William's age is equal to $\frac{1}{2}$ of John's, and the sum of their ages, 16: what is the age of each?

ANALYSIS.—*Since $\frac{1}{4}$ of William's age = $\frac{1}{2}$ of John's, his age must be 4 times $\frac{1}{2}$ of John's = $\frac{4}{2}$ = 2 times John's; hence, the ages of the two boys are equal to 2 times John's age plus John's age = 3 times John's age, which is equal to 16: Therefore, John's age is $\frac{1}{3}$ of 16 = $5\frac{1}{3}$ years.*

10. If $\frac{1}{2}$ of Charles' age equals $\frac{1}{6}$ of John's, and the sum of their ages is 16, what is the age of each?

11. Divide 15 into two such parts, that $\frac{1}{11}$ of the first shall be equal to $\frac{1}{4}$ of the second.

12. A mother divided 56 pins between Jane and Nancy, so that $\frac{1}{5}$ of Jane's was equal to $\frac{1}{2}$ of Nancy's: how many had each?

13. If $\frac{1}{6}$ of John's marbles is equal to $\frac{1}{8}$ of James', and together they have 56, how many has each?

14. Two persons, A and B, at a tavern, spend 80

cents of which, twice what A spends is equal to 3 times what B spends : how much is spent by each ?

15. The sum of the ages of 2 persons is 56 years, and twice the age of the elder is 6 times the age of the younger : what is the age of each ?

16. A tailor has 48 yards of cloth, in 2 pieces ; $\frac{2}{5}$ of the longer piece is equal to $\frac{2}{3}$ of the shorter piece : how many yards in each ?

17. A farmer bought pigs and sheep, in all 33 ; $\frac{2}{7}$ of the pigs was equal to $\frac{1}{2}$ of the sheep : how many were there of each kind ?

18. Three-fourths of a son's age is equal to $\frac{1}{4}$ of the father's age, and the sum of their ages is 80 years : what is the age of each ?

19. There are 125 sheep in 2 fields, $\frac{4}{5}$ of the number in one field being equal to $1\frac{1}{5}$ times the number in the other : how many in each field ?

20. A father's age is such, that $\frac{5}{8}$ of it is equal to $1\frac{3}{4}$ times the age of his son, and the difference of their ages is 36 years : what is the age of each ?

21. A flagstaff, 52 feet long, is so broken by the wind, that $\frac{1}{3}$ of the top piece is equal to $\frac{3}{4}$ of the piece left standing : how long are the pieces ?

22. James being asked how many marbles he had, replied : "I have 55, black and red, and $\frac{2}{7}$ of the black make just as many as $\frac{4}{9}$ of the red. Pray, how many have I of each sort ?"

23. James and John have 50 cents ; 3 times James' number is equal to 7 times John's : how many has each ?

24. A piece of cloth is divided into 3 parts ; one piece is 4 yards long, which is $\frac{1}{8}$ of the length of the other two ; but of these two pieces, the shorter is $\frac{1}{3}$ of the longer : what is the length of each part ?

LESSON VI.

1. Divide the number 18 into two such parts, that the ratio of the parts shall be the same as 2 to 4.

ANALYSIS.—18 *must have the same ratio to each of the parts, as* 6, *the sum of* 2 *and* 4, *has to* 2 *and* 4 : *the ratio of* 6 *to* 2 *is* $\frac{1}{3}$, *and of* 6 *to* 4, $\frac{2}{3}$: *Therefore, one of the numbers is* $\frac{1}{3}$ *of* 18, *and the other,* $\frac{2}{3}$ *of* 18.

2. Divide the number 28 into two parts, such that their ratio shall be the same as 5 to 9.

3. Divide the number 34 into two parts, such that the first shall be eight-ninths of the second.

4. Divide 34 into two such parts, that the first shall be one and one-eighth times the second.

5. Two men bought a piece of muslin, containing 30 yards; one paid $2, and the other $3 : how many yards belonged to each ?

6. Two men hired a pasture, for $24; one pastured 5 horses, and the other 3 : how much should each pay ?

7. Two men hired a pasture, for $72; one pastured 3 horses for 5 weeks, and the other 7 horses for 3 weeks: what proportion should each pay ?

8. Two men agree to do a piece of work, for which they are to receive $88; the first sends 4 hands for 3 days, and the second 5 hands for 2 days : how much should each receive ?

9. William has 9 cents, and John 7; they buy 96 apples : how many apples should each have ?

10. A grocer weighs out 24 pounds of sugar for 2 persons, giving 2 pounds to one as often as he gave $\frac{2}{3}$ of a pound to the other : how much did he give to each ?

11. A draper divides a piece of cloth, containing 36

yards, between 2 persons, giving $2\frac{1}{2}$ yards to the one, every time that he gave $3\frac{1}{2}$ yards to the other: how much did each receive?

12. A man distributed 78 cents among 8 beggars, 3 of whom were men and 5 were women; he gave twice as much to each woman as to each man: how much did he give to each?

13. James and John start from the same place, travel the same way, and take steps of equal length; James steps 4 times, while John steps but 3: how far will they be apart, when they together have walked 14 miles?

14. Charles has 5 marbles and John 9, and they agree to share their winnings or losses in the same proportion; after several games, they find that they have won 42: how are they to be divided?

15. A and B enter into partnership; A puts in 7 dollars, and B 11; they make 9 dollars by the operation: how should it be divided?

16. A and B enter into partnership; A puts in 6 dollars for 2 months, and B 5 dollars for 3 months; they gain 81 dollars: what is the share of each?

17. William and Samuel start from the same place, travel in opposite directions, and take steps of equal length; William steps 4 times, while Samuel steps but 3: how far will each have traveled, when they are $3\frac{1}{2}$ miles apart?

18. Three persons buy a piece of cloth, containing 48 yards; the first puts in $5, the second $9, and the third $10: what was each one's share?

19. A person met three beggars,—a boy, a mother, and father,—and distributed 84 cents among them; for every 5 cents he gave the boy, he gave the mother 7, and the father 9: how much did he give to each?

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20. Three persons hire a pasture, for which they pay $56; the first puts in 2 horses for 3 weeks, the second 5 horses for 2 weeks, and the third 9 horses for $1\frac{1}{3}$ weeks: how much ought each to pay?

21. Two barrels of flour, costing 12 dollars, are consumed by 3 persons; the first ate from them 2 months, the second 3 months, and the third 5 months: how much should be paid by each?

22. Divide $84 among 3 persons, so that every time the first receives 3 dollars, the second shall receive 4, and the 3d, 5: what is the portion of each?

23. A man hires 6 men and 10 boys, and agrees to give them 104\frac{1}{2}$ for a certain piece of work: now, supposing a man to be equal to two boys, how much would each receive?

24. Three persons hire a pasture for sheep, for which they pay 12 dollars; the second puts in twice as many sheep as the first, and the third three times as many as the first. The sheep of the first man are in twice as long as those of the second, and the sheep of the third man are in $\frac{2}{3}$ as long as those of the second: how much should each pay?

LESSON VII.

1. If 5 men can do a piece of work in 1 day, how long will it take 1 man to do it?

2. If 1 man can do a piece of work in 8 days, how long will it take 4 men to do it?

3. John can do a piece of work in 2 days, and Charles can do the same work in 3 days: in what time can they, by working together, do the work?

ANALYSIS.—*In as many days as the work that they can do in a day, is contained times in the whole work: John can do $\frac{1}{2}$ the work and Charles $\frac{1}{3}$ the work in 1 day, and both can do the sum of $\frac{1}{2}$ and $\frac{1}{3}$, which is $\frac{5}{6}$ the work: $\frac{5}{6}$ of the work is contained in the whole work as many times as $\frac{5}{6}$ is contained in 1, which is $\frac{6}{5}$ times $= 1\frac{1}{5}$ times: Therefore, they together can do the work in $1\frac{1}{5}$ days.*

4. A can do a piece of work in 3 days, and B can do it in 5 days : in what time can they together do it ?

5. A cistern is to be filled by two pipes ; one can fill it in 2 hours, and the other in 5 : in what time can they, running together, fill it ?

6. A cistern is to be filled by 3 pipes ; the first can fill it in 2 hours, the second in 3, and the third in 4 : in what time will the three fill it, running together ?

7. A can mow a field in 1 day, B in 2 days, and C in 3 days : in what time can they, working together, mow it ?

8. A man and his wife usually drank a gallon of beer in 12 days ; but when the man was from home, it lasted the wife 30 days : how many days would the man require to drink it ?

9. A can do a piece of work in 3 days ; A and B, together, can do it in $1\frac{7}{8}$ days : in what time can B do it, working alone ?

10. John can do a piece of work in 2 days, and John and James, together, can do it in $1\frac{1}{5}$ days : in what time can James do it, alone ?

11. A cistern can be filled by one pipe in 2 hours, and by 2 pipes in $1\frac{3}{7}$ hours : how long will the second pipe require to fill it, if running alone ?

12. A cistern can be filled by 3 pipes in $1\frac{1}{12}$ hours,

one of the pipes can fill it in 2 hours, and another in **3** : how long will it require the third to fill it, if running alone ?

13. If two families consume a quantity of provisions in $1\frac{1}{3}$ weeks, and one family alone would consume the same provision in 4 weeks, how long would it last the other ?

14. A quantity of flour will last one family six weeks, and the same flour will last another family 3 weeks ; it is found that one-third of the flour is spoiled : how long will the remainder last both families ?

15. Three carpenters can finish a house in 2 months ; two of them can do it in $2\frac{1}{2}$ months : how long will it take the third to do it alone ?

16. A can mow a field in 2 days, B can mow it in 3 days, but by the aid of C, they can mow it in $\frac{6}{11}$ of 1 day : how long will it take C to mow it, alone ?

17. A can build a wall in 10 days, and B can do it in 15 days ; after working together 3 days, B leaves A to finish it : in what time will he finish it ?

18. A can do a piece of work in 12 days, and B in 15 days ; after working together 2 days, they hire C to help them : supposing C able to do the work alone in 20 days, how long would it require the three to finish it ?

19. A certain amount is sufficient to support a man alone 8 weeks, and to support his wife alone 10 weeks : how long would $\frac{7}{8}$ of the amount support both of them together ?

20. In 5 weeks A can earn $30 ; B can earn the same amount in 4 weeks : how long would it require them to earn $54, by working together ?

LESSON VIII.

1. A laborer engaged to work for 16 days, on these conditions : for every day he labored he was to receive 4 shillings, and for each day that he was idle he was to pay 2 shillings for his board ;—at the end of the time, he received 52 shillings : how many days did he work, and how many days was he idle ?

ANALYSIS.—*Had the laborer worked* 16 *days, he would have received* 64 *shillings: he received only* 52 *shillings: he lost* 12 *shillings by idleness. Since every day he was idle, he paid* 2 *shillings for board and lost 4 shillings in wages, he lost* 6 *shillings a day: Therefore, he must have been idle as many days as* 6 *is contained times in* 12, *which is* 2 : *he was idle* 2 *days, and worked* 14 *days.*

2. An apprentice was to receive 3 shillings a day, for 26 days, for every day he worked, and to pay 1 shilling a day for his board when idle, and 20 shillings for clothes ; at the end of the time, there was due him, in cash, 30 shillings : how many days did he work ?

3. A merchant bought 50 yards of calico, on these terms : he was to pay 3 dimes a yard for all that was perfect, and to receive 1 dime a yard on all that was imperfect, as forfeit ;—at the settlement, he paid 11 dollars : how many yards were injured ?

4. A grocer purchased 30 fowls ; for each turkey he was to pay 11 dimes, and for each fowl, not a turkey, he was to pay 1 dime ; on settlement, he paid $24 : how many were there of each sort ?

5. A farmer hired a father and son to do 20 days' work between them ; the father was to have a dollar for

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every day he worked, and the son 75 cents; at the end
of the time, the amount paid was 17 dollars: how many
days did each work?

6 A laborer engaged to work 20 days, and was to
receive 9 shillings and board for every day he worked,
and to pay 2 shillings a day for his board and 1 shilling
forfeit, every day that he was idle; in settling, he re-
ceived 84 shillings: how many days did he work?

7. A hare is 25 of his own leaps before a greyhound,
which is pursuing him; the greyhound makes 2 leaps
while the hare makes 5; but 1 leap of the greyhound, is
equal to 3 of the hare's: how many leaps will the grey-
hound make, before he overtakes the hare?

ANALYSIS.—*Since the greyhound makes 2 leaps while
the hare makes 5, in the time that the greyhound makes
1 leap the hare will make $2\frac{1}{2}$ leaps: but 1 leap of the
greyhound is equal to 3 leaps of the hare; hence, every
time the greyhound jumps, he will gain on the hare $\frac{1}{2}$
of a hare's leap: Therefore, he must make, in order to
overtake him, as many leaps as $\frac{1}{2}$ is contained times in
25, which is 50. Hence, the hound must make 50 leaps.*

8. James is in pursuit of John, who is 12 of his own
steps in advance of James; James steps 3 times, while
John steps 4 times; but James' steps are twice as long
as John's: how many steps must James make, to over-
take him?

9. James is 10 of his own paces behind John, and in
pursuit of him; James steps 3 times, while John steps 4
times; but James' steps are twice as long as John's:
how many steps must James make, to overtake him?

10. A hare was 40 of his own leaps ahead of a grey
hound, when the latter started in pursuit; the hound

makes 2 leaps while the hare makes 5, but 4 leaps of the hound are equal to 14 leaps of the hare : how many leaps must the greyhound make, to overtake the hare ?

11. William chases Henry, who is 42 feet in advance, around a circular walk of 100 feet; the steps of each are 3 feet, but William takes 6 steps while Henry takes but 5 : how many steps must William make, to overtake Henry ?

12. Mary is 24 years old, and Jane is 4 : how many years must elapse, before Mary's age will be just double Jane's ?

ANALYSIS.—*At Jane's birth, 4 years ago, Mary's age was 20 years, and Jane's was 0. Twenty years from that date, Mary's age will be 40 years, and Jane's will be 20, when Mary's is double Jane's: Jane's age is 4 years: Therefore, 16 years must elapse, before she is 20 years old.*

13. A mother is 36 years old, and her daughter 12 : how long before the age of the mother will be double that of the daughter ? What will then be the age of each ?

14. A father is 46 years old, and his son is 16 : in how many years will the father's age be twice the sons ?

15. A father is 60 years old, and his son is 35 : how long since the age of the father was double that of the son ? What was then the age of each ?

16. A mother is 48 years old, and her daughter 30 : how long since the age of the daughter was half that of the mother ? What was then the age of each ?

17. A mother is 48 years old, and her daughter 10 : how long before the age of the daughter will be $\frac{1}{3}$ that of the mother ?

ANALYSIS.—*At the daughter's birth, the mother was* 38 *years old : what number, added to* 38, *will make the sum* 3 *times the number added? Since every number has* 2 *halves, if* 1 *half be added, the sum will be* 3 *times the half : the half of* 38, *is* 19: *Therefore,* 19 *is the number which, added to* 38, *makes the sum* 3 *times* 19, *or* 57. *Nine years, therefore, must elapse, before the daughter is* ⅓ *as old as her mother.*

18. A father's age is 45 years, and his son's 9 : how long before the age of the son will be one-fourth that of his father ? What will then be the age of each ?

19. A mother is 54 years old, and her daughter 20 : how long since the age of the daughter was one-third that of the mother ? What was then the age of each ?

20. A father is 54 years old, and his son 30 : how long since the age of the father was 4 times that of the son ? What was then the age of each ?

21. A father has so arranged his property, that each child shall receive, each year from birth, the same amount of interest ; Thomas is 18 years old, and Charles is 4 : in how many years will all the interest of Charles just equal the half of that of Thomas ? How old will each then be ?

22. At what time between 3 and 4 o'clock, will the minute and hour-hand of a watch be together ?

ANALYSIS.—*The minute-hand moves around the face once, while the hour-hand moves from one number to the next : consequently, the hour-hand moves* $\frac{1}{12}$ *as fast as the minute-hand. While the minute-hand passes over one-minute space, the hour-hand will pass over* $\frac{1}{12}$ *of that space, and the minute-hand will gain* $1\frac{1}{12}$ *of that space in* 1 *minute of time.*

At 3 *o'clock, the hour-hand was at* 3, *and the minute-hand at* 12 ; *and to gain* 15 *minute spaces, will require as many minutes as* $1\frac{1}{12}$ *is contained times in* 15, *which is* $16\frac{4}{11}$: *Therefore, the time is* $16\frac{4}{11}$ *minutes past* 3 *o'clock.*

23. At what time between 5 and 6 o'clock, will th minute and hour hands be together?

24. At what time between 9 and 10 o'clock, will the minute and hour hands be together?

25. At what time between 11 and 12 o'clock, will the minute and hour hands be together?

LESSON IX.

PROMISCUOUS QUESTIONS.

1. Five men agree to do a piece of work for $60, each to receive an equal part; when the work is half done, two of the men quit, and the other three finish it: how much should each receive?

2. James went out hunting, and shot one of every 5 squirrels which he saw; had he seen 10 more, and killed in the same proportion, he would have brought home 6: how many squirrels did he see?

3. A lady wishes a dress, and does not know whether to buy silk, or muslin. The silk costs 9 shillings a yard, and the muslin 3; if she purchases the silk, it will cost 72 shillings more than the muslin: how many yards did she need?

4. A person hired a man and 2 boys; to the man he gave 6 shillings a day, to one boy 4, and to the other 3 shillings; at the end of the time, he paid them 104 shillings: how long did they work?

5. If $\frac{8}{9}$ of a piece of broadcloth, containing 18 yards, cost \$32, what was the cost per yard?

6. What is the value of 50 barrels of flour, if $\frac{2}{5}$ of them are worth \$6 a barrel, and the remainder \$4$\frac{1}{2}$?

7. A man sold a barrel of flour for \$4, which was $\frac{2}{3}$ of what it cost: how much did he lose?

8. A man sold a cow for \$18, which was $\frac{6}{7}$ of what is cost: what was the cost?

9. A man spends $\frac{1}{5}$ of his monthly income for a hat, and twice as much for a coat, and has \$10 left: how much does he receive a month?

10. A person gave $\frac{1}{6}$ of his money to each of 5 persons, and had 4 cents left: how much had he at first?

11. What will be the cost of a bag of coffee, if $\frac{2}{5}$ of it cost \$4$\frac{2}{3}$?

12. A person being asked the time of day, said, that the time past 12 o'clock, M. (or noon), was $\frac{1}{4}$ of the time past the previous midnight: what was the time?

13. A man starts on foot from Albany for New York, and at the end of the first day finds that he has 125 miles yet to travel, which was just $\frac{5}{6}$ of the whole distance: what is the whole distance?

14. James has \$8 more money than John; 5$\frac{1}{2}$ times this difference equal 1$\frac{5}{6}$ times James' money: how much has each?

15. What number is that, from which if 2 be subtracted, $\frac{2}{3}$ of the remainder will be 4?

16. A young lady had a portion at marriage; she expended $\frac{4}{5}$ of it in furniture, gave \$6 to each of two sisters, and had \$28 left: how much had she at first?

17. A tailor having a piece of cloth, cut it into 2 parts, one of which was 2 yards less than $\frac{1}{2}$ of the piece; he then cut the smaller piece into 2 equal parts, each of

which contained 14 yards: how many yards in the piece?

18. A person, after spending $\frac{1}{2}$ of his money, and then $\frac{1}{3}$ of the remainder, had 8 dollars left: how much had he at first?

19. A man, at play, lost $\frac{1}{3}$ of his money, and the next night lost $\frac{1}{4}$ of the remainder, when he found that he had but $12 left: how much had he at first?

20. A man paid $\frac{2}{5}$ of his year's bill; after which, he paid $\frac{1}{3}$ of what was left, and yet owed 12 dollars: how much was the bill?

21. A market-woman bought a certain number of eggs, at the rate of 4 for 3 cents, and sold them at the rate of 5 for 4 cents, by which she made 4 cents: how many eggs did she buy?

22. A cistern has 2 pipes, one of which will fill it in $2\frac{1}{2}$ hours, and the other in $3\frac{1}{2}$: in what time will they fill it, running together?

23. A man bought a harness, a carriage, and a pair of horses, for $290; the horses cost $70 more than the carriage, and the carriage $50 more than the harness: what was the cost of each?

24. A piece of cloth, containing 81 yards, is cut into two parts; $\frac{2}{9}$ of the whole piece is equal to $\frac{2}{3}$ of the smaller: how many yards must be added to the less piece, to make the two pieces equal?

25. If $40 be divided between 2 persons, so that one shall have $3 every time that the other has two, how much will each receive?

26. A and B enter into trade together; A puts in $2 every time B puts in $5; A's money remains in 12 months, and B's 8; they make a profit of $128: how should it be divided between them?

27. Two men hired a pasture for $40, and agreed that the pasture of 2 cows should count for the pasture of 1 horse; one pastured 4 cows and 2 horses for 3 weeks, the other 2 cows and 3 horses for 2 weeks: how much should each pay?

28. In a school of 44 pupils, there are $1\frac{3}{4}$ times as many girls as boys: how many of each?

29. A merchant sold $6\frac{3}{4}$ yards of cloth at $4 a yard, and took his pay in equal quantities of rye and wheat, the former at 50 cents and the latter at $1 a bushel: how much of each did he buy?

30. A market-woman bought a certain number of eggs at 3 for 2 cents, and an equal number at 5 for 4 cents; she paid, for both lots, 44 cents: how many did she buy?

31. A man having a goose, pig, and calf, was asked the value of them; he said that the three were worth 30 shillings, that the goose was worth one-third as much as the pig, and the calf $1\frac{1}{2}$ times as much as the goose and pig together: what was the value of each?

32. A tailor cut 6 coats from a piece of cloth, after which it measured 24 yards; he then cut 5 pair of pantaloons, which took $\frac{1}{2}$ as much as the coats, when it was found that one-half of the piece was left: how many yards did the piece contain?
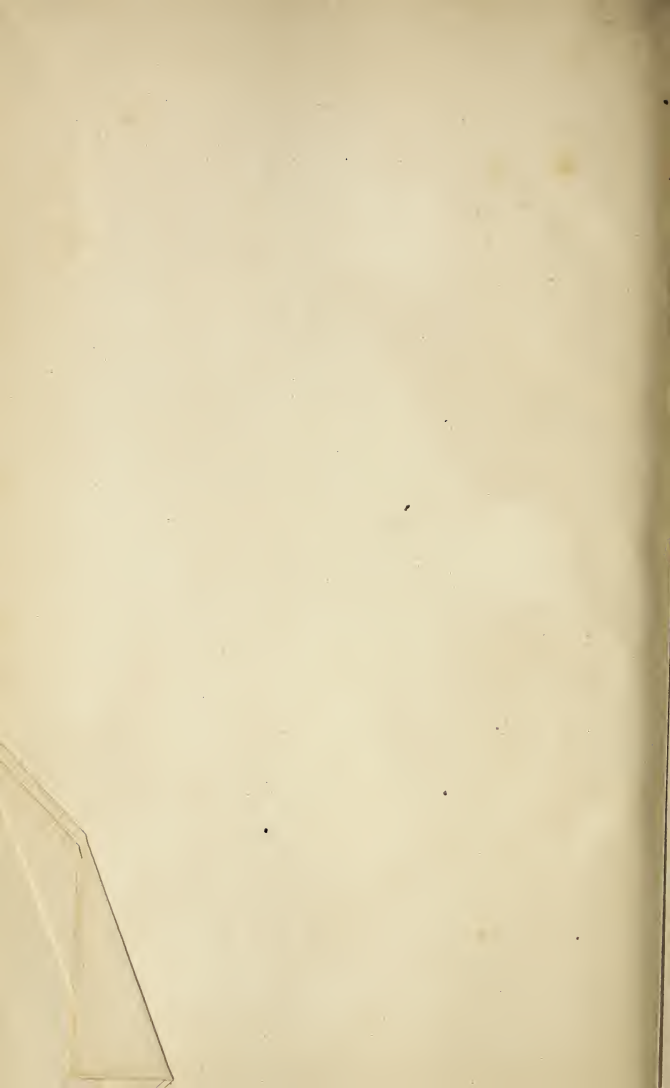
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